BRASS WORLD
AND PLATING — POLISHING — FINISHING

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Copper Plating for Various Finishes

Different Types of Decorative Effects on Copper

By "ELECTROGRAPHER"

WRITTEN ESPECIALLY FOR BRASS WORLD

SOME time ago the writer contributed an article to these columns on "Brass Plating for Various Finishes," giving some alternate methods for getting colors that are at present popular for this alloy. While copper plating does not lend itself to forming a base from the vat for so wide a range of choice in finishes, there are some little kinks that are worth knowing and trying even in regard to this metal. When goods of fair quality have to be finished in this way there is no denying that the base provided by the coppering process can be a means for imposing thereon a superior appearance for the article. While it is possible to get a range of coloring to suit every requirement by the subsequent bronzing process which, of course, has been known for years, the uniformity attainable in the bases for all those in the vat is more reliable and the delicacy of shade nearer to artistic ideas and conception. On these bases the bronzing liquids are more constant and regular in results.

In ordinary coppering it is well known that the surface on which the copper is deposited, especially if this is thin, makes considerable difference as note the variation betweeen a piece of clean black iron and a polished one when plated. The dull brown tone of the former contrasts unfavorably with the bright red of the latter. Apart from the working of the plating solution it is useless to depend, however, on these bases for effect. Having settled what the finish of the foundation metal must be the after effects should be determined by the deposit. Here we have two predetermining causes of the ultimate finish and neither of them can be neglected with impunity. The bright red may be desired on differently prepared surfaces, or it may not be required on uniformly finished surfaces and the difference in the deposit is expected to produce the result aimed at.

Suppose as an illustration, that the same kind of article was required to be finished both in Florentine, and in red, bronze. The copper deposit may very well be made to form an easy base for both. The former bronze is a rather special finish generally used for good class wares, and occasionally some trouble is taken to get it perfect. If the basic coloring is right, much of this trouble is obviated. In such a case the bright red of the sulphate solution is of no use. Not that a less red tint is obtainable only by a potassium cyanide solution, but because this can be made more amenable to different requirements, as will be shown presently.

While it is known that almost any shade of deposit can be obtained by altering the constituents of the solution, as was shown in the former article, it is now presumed that any tampering with this is undesirable and that any variation in the color of the deposit must be obtained by other means. The use of zinc anodes may be thought of as a method for attaining the desired ends but on deeper reflection it can scarcely be affirmed that these would have no alternative effect on the solution when one remembers the action that takes place. In a brassing solution, where adjustments of the constituents of the bath are a matter of frequent necessity, the working of zinc anodes may not seriously inconvenience the operator, but in a coppering vat that is desired to be kept intact and up to proper pitch the proposition is different.

Here is where cadmium anodes come in. These can be more safely used in a coppering solution and will give just the amount of variation in the color of the deposit that may be required to fit it for receiving a Florentine or Chinese finish rather than a red one. The slight browning of the deposited copper can be obtained by a judicious use of these anodes, the amount of surface being dictated by the state of the bath, temperature, etc. According to the quantity of surface, deposits varying from the usual red to an aluminum bronze can be obtained without in any way seriously altering the character of the solution. It is not contended that this should be done with a coppering solution that must be kept intact—no special bath for any metal should be tampered with—but for ordinary purposes when the cadmium anodes are withdrawn no fears need be entertained of consequent damage worth

speaking of, unless the use of them was long and persistent when, of course, the character of the bath would be affected.

In bronzing deposits so obtained some care is necessary in using sulphides of arsenic. The duration of a dip in such solutions should be of the briefest. If not satisfactory in one brief dip it is better to adopt a weaker solution and dip repeatedly until the desired effect is obtained. In imitating Chinese bronzes, so greatly admired on high class goods, not much use is made of the native recipe with its bills and livers of ducks in these days although the Chinaman got such fine results from it. A better and quicker method is to so prepare the base by deposits prepared as recommended above and the use afterwards of one of the simpler recipes now well-known to the trade.

Not only for plain bronzes, such as that just referred to, but where relieving is required is the previous preparation of the base useful. For instance, if two articles are prepared by plating, one in a plain copper bath and the other by means of adjustment of cadmium anodes to suit, and both are blacked over after, the relieving will be a different matter for the first from what it will be for the latter. While in the case of the former only sufficient of the black oxide needs removing as will show the copper base in strict moderation, the browner deposit may be exposed much more, in fact nearly all over with good effect. Of course, the bronzes would not be of the same class, the latter might approximate to a Florentine, but the idea is to show how applicable to a variety of finishes the graduated deposit is.

In the case of plating tinplate the effect got by the varying shades of deposit after bronzing is even more noticeable and appreciated. The brightness that in the red copper bronze is rather staring is not so objectionable in the modified deposit. It is rather curious that bright tinplate will not itself tone down the redness of even a thin deposit of copper but a slight addition of tin salts to a suitable coppering bath will give a brown bronze shade. This mode of obtaining a modification of color has not been given here for the simple reason that the method recommended above is better, easier and safer. With the majority of bronze finishes for coppered surfaces only a slight deviation in tone is requisite which is the reason for the statement in the last sentence.

There is the further advantage in preparing a suitable base for bronze finishes in the endurance of the latter. In using some recipes for brown bronzing the result is rather transient when the article comes to be handled and the red copper showing through does not improve the appearance. As these toned bronzes are now becoming more popular their wearing qualities may demand attention on the part of manufacturers. The method of obtaining these with the minimum of trouble and the maximum of certainty is that explained above by which means judiciously applied almost any shade of color from a yellow to ordinary copper is possible of easy attainment.

Nor must it be overlooked that not only are there these advantages but the further one of choice of alternate recipes for bronzing, so that one inimical to the well-being of a thin deposit may be supplanted by a safer one which may be difficult and ineffective on a base of different tone of color.

Removal of Acid Fumes From Pickling Rooms

By DR. JAMES SILBERSTEIN

VARIOUS methods are being used in order to remove the troublesome acid fumes in pickling rooms. A common method is ventilating by means of roof ventilators and propeller fans. This scheme is unsatisfactory because it does not prevent the fumes from circulating through the building, attacking the steel and iron work and being inhaled by the workmen.

Another method of ventilating is by means of hoods, placed directly above the tanks and connecting them by ducts to fans. This method is also unsatisfactory because the hoods generally interfere with the handling of material to be pickled and because only a part of the fumes is removed. Acid fumes are heavier than air, and the suction required to make all fumes rise to the hoods is therefore so strong that this method is not practical. A third method is to introduce warm air near the tanks. This prevents the formation of fog and keeps the atmosphere clear, but the scheme does not prevent the acid fumes from filling the room.

It is evident that a satisfactory method should remove the fumes as soon as they are generated from the surface of the pickling bath, and carry them outside of the building without getting in contact with workmen and building structure. In the installation shown in the pictures a fan is drawing the fumes directly from the surface of the tanks through long narrow openings along the sides to ducts leading to the fan, which discharges the fumes to a stack. Fig. 1 shows the vapors rising from the tanks when the fan is not in operation. In Fig. 2 the fan is being operated. No vapor can be seen rising above the edge of the tanks, all vapors being drawn directly into slots, so that only a white film of vapor can be seen covering the surface of the tanks.

Fan and ducts must be made of materials capable of withstanding the corrosive action of the fumes. Ducts made of a good grade of lumber and painted or impregnated with acid proof paint, are found very satisfactory. The fan, however, presents a more difficult problem. If a steel fan is used, it is necessary to paint the fan about once a week, in order to make it stand up for a reasonable length of time. In some places a fan having a wood housing and a steel plate paddle is used. In such cases, however, a comparatively large fan is required, making the upkeep high. Good material for the construction of acid resisting fans has proved to be high nickel alloys like Monel metal. When using Monel metal it has been found necessary to paint the fan inside only two or three times a year and it will stand up for years without any replacements.

Solution Lacks Free Cyanide

Q.—I am sending you a sample of solution for analysis. I would like to have you tell me what is wrong with this solution, as it does not produce good work.

What is a good book on electroplating practice?

A.—Your solution analyzes as follows:

Copper	4.74 ozs.
Free cyanide	.10 ozs.

Your solution is entirely too low in free cyanide. Add two ounces of sodium cyanide per gallon of solution. Heat the solution to 130 °F., and also add 1 oz. of hyposulphite of soda for every 100 gallons of solution.

—OLIVER J. SIZELOVE.

Survey of Foundry Machine Costs

The performance of the split pattern foundry machinery manufactured by the Tabor Manufacturing Company, Philadelphia, Pa., has been surveyed by the A. C. Nielson Company, engineers, in collaboration with Howard Sheeler, president of the Sheeler-Hemsher Company, Philadelphia, in whose plant the machines are in use. The survey, which is here republished in part from "Graphite," published by the Joseph Dixon Crucible Company, Jersey City, N. J., contains certain claims for all of which the surveying engineers are responsible. The excerpt from the survey is as follows:

In molding brass and aluminum at the foundry of Sheeler-Hemsher Company, Philadelphia, Tabor machines have proved themselves, after years of service, able to give entire satisfaction and a reduced molding cost.

The foundry does a jobbing business in brass and aluminum and produces castings varying all the way from one ounce to 1000 pounds and in shapes as called for by the trade.

The following Tabor equipment is in use:

1—12″ x 18″ split pattern machine.
1—24″ hand-ram portable rollover.
2—18″ jarring squeezers.
1—18″ x 24″ plain jar machine.

Albany sand is mechanically sieved, tempered and transferred to the floor by hand methods. It is shovelled into the molds which in their turn are mostly moved by hand except in the case of large sizes which require crane service. Metal is poured direct from crucibles into the molds.

Both patterns and flasks may be either of wood or metal with the tendency and preference toward metal for each. As a great deal of the success of molding depends on the condition of both patterns and flasks, care is exercised to keep them in the best of condition at all times.

This survey will describe methods used with the split pattern machine, develop costs for machine molding and make comparison with bench and snap flask methods.

Flasks: With this machine tight flasks of many sizes are used but the size mostly employed is 12″ x 18″ with a depth varying from 3½″ to 5″ for both cope and drag. The weight of castings varies from ½ to 20 lbs. and the weights of the half molds with sand, flask and plates average 80 lbs.

Patterns: Steel pattern plates of 3/16″ stock are being used in preference to the heavy iron pattern plates ordinarily employed. An iron plate is first cut down 3/16″ in thickness and then fitted with screws so that it can be used interchangeably with any of the thin steel plates. This not only makes patterns easier to handle and more convenient for storage but also effects a saving of $7.00 to $7.50 per mounted pattern. A total of about a thousand such patterns are in use in this shop and the investment in them is approximately $700 less than if iron plate patterns were used.

The thin steel plate patterns have another marked advantage on small-lot work. Some of the plates are line cut at half-inch intervals, with lines running in both directions, and have small holes drilled in them wherever these lines intersect. Patterns for small-lot jobs can then be mounted on these plates, either with glue or by passing screws through a few holes.

A mounting job which formerly took half a day is thus done in 15 to 20 minutes and the steel mounting plate is always usable again for later jobs. It has been found economic to schedule runs of as few as 12 molds on the split-pattern machine in cases where a single fairly large pattern is used in each mold.

Production: The foundry operates 9 hours a day on a 5-day-a-week schedule. Production in nine hours with the machine is 125 molds, with one molder at $9 and auxiliary labor amounting to $2.50. This is equivalent to $.09 per mold.

Machine Costs: Based upon an assumed life of 10 years, fixed charges amount to $71.85 a year. Air cost pro-rated to the split pattern machine adds $81.25. With an allowance of $25 for lubrication and cleaning the total fixed and operating cost is $178.10—equivalent to $.685 a day or $.0055 per mold. Thus the total molding cost—machine and labor—is $.095.

ADVANTAGES OVER BENCH AND SNAP FLASK METHODS

In Cost: The survey gives also the outputs and labor costs for bench and snap flask methods. For the former, with loose-pattern molds arranged for multiple-gate pouring, the production is 25 in 9 hours, at a cost of $410 each. The saving is substantial—$.315 per mold and $39.38 a day based on machine production. For the snap flask method a production of 80 molds a day at the same labor cost results in a cost per mold of $.128. The saving being effected by the machine is $.033 per mold and $4.12 per day.

It will be seen that the first cost of the machine is returned in savings over bench work in 12 days, and over snap flask methods in 113 days.

In Rejections: Machine-made molds produce more uniform castings, save in metal and reduce rejections. These are evidenced by the following instances. In one run of 800 pieces only 3 were rejected on inspection. This gives a rejection percentage of .375. The average of rejections runs from 2 to 2½ per cent, in spite of rigid standards.

In Uniformity: In another instance the uniformity of the castings reduced the former average weight of 13 lb. by ⅔ lb. The price was $.30 per lb. and the customer was pleased to get the benefit of this reduction of $.20 per casting. When a machine or ground finish is required on a casting the greater uniformity obtained reduces the amount of metal which must be removed.

In Pattern Wear: There is far less wear on patterns. A few wood patterns are still in service that have been in use as required for 20 years. Also, fewer patterns are required than with hand methods, the machine only requiring a half pattern in most cases where hand methods would require a whole pattern.

In Labor: In a comparison of costs the labor reduction is large. In labor alone the reduction is 78 per cent over bench work and 29 per cent over hand-rammed snap flask work.

SUMMARY

Brass and aluminum foundry uses Tabor equipment for wide variety of jobbing work.

Split pattern machine used mostly on 12″ x 18″ flasks of depths 3½ to 5 inches. For castings weighing from ½ to 20 lb. patterns and flasks are largely of metal.

Use of thin steel plate patterns has advantages due to: Lower pattern investment; easier pattern handling and storage; adaptability on small-lot work.

Average production in 9 hours is 125 molds. Molder and auxiliary labor amount to $11.25. Machine cost is $.685 a day. Making cost per mold $.095. Bench methods produce 25 molds a day. Hand-rammed snap flask methods produce 80 molds. At costs respectively of $.410 and $.128. Tabor machine saves 76.8 per cent over bench molding. Saves 25.8 per cent over hand-ram snap flash work. Reduces wear on all patterns.

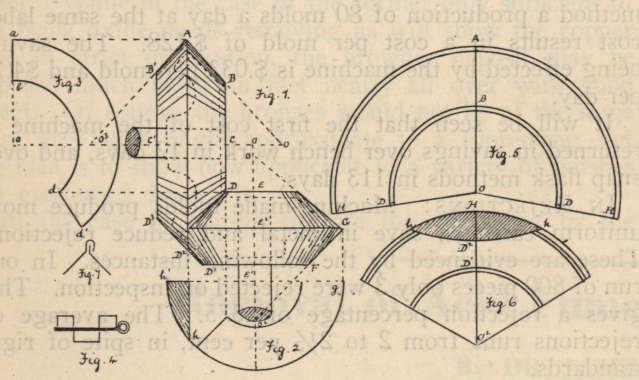
How to Make Bevel Wheel Guards

Calculations, Drawings and Operations Necessary to Do This Type of Sheet Metal Work

By WILLIAM MASON
Metal Worker

WRITTEN ESPECIALLY FOR BRASS WORLD

FIRST draw an outline elevation of the level wheel and guard in position. Thus, referring to Fig. 1, draw lines intersecting at right angles at A to represent the centre lines of the shafts, and then complete the projection of the wheels as shown by the dotted lines. At a distance suitable for clearance, draw lines parallel to the faces and edges of each wheel, and A B C D E F G T^1 D^1 D^2 B^1 would be the outlines of the cones forming the case. Draw A D^2, and from G draw a line parellel to



Drawings for Construction of Bevel Wheel Guards

D F^1. Next draw a line parallel to A D^2, and draw projection from A, O, and B to a, b, o, Fig. 3. Then with o as centre, draw arcs of circles and a projection from D, Fig. 1, to cut the smaller arc at d, Fig. 3; then draw a radial line to cut the outer arc at d^1, when a b d d^1, Fig. 3, is a half plan of the part cone A B D, Fig. 1. The same method of working will give the plan of the cone D F^1 G. By reference to Fig. 1 it will be seen that the cone G F^1 D^1 is cut away where it joins the cone A D^2 D^3 B^1. To find the exact amount to be removed, produce A D^2 to cut the semicircle g h^1 at h, Fig. 2, then the cross-hatched part will not be required. Produce the slants of the four cones until they reach the centre lines at O, O^1, O^2, and O^3 Fig. 1, and the length from each centre to the larger diameter of the corresponding cone will be the radius for the pattern. For the cone K, Fig. 1, with the length O A as radius draw an arc. Make A H, Fig. 5, on each side of the center line A O equal in length to a d^1, Fig. 3, and then with O B, Fig. 1, as radius draw an inner arc D B D, Fig. 5; then an allowance for wiring around the smaller arc with the corners notched as shown, and an allowance outside for a single edge will complete the pattern. The pattern for the cone M, Fig. 1, is worked in the same manner, and the cone D, Fig. 1, is made in two pieces, with the seam arranged along the line at C^1. The cone N, Fig. 1, is also in pieces, with the seam along the line E^1 E^2. Work the pattern for the half cone by the method described above, then mark off the distance D^1 D^2, Fig. 1, upon the centre line as D^1 D^2, Fig. 6. Now transfer the length round the curve h h^1, Fig. 2, to Fig. 6 at h H h, draw a curve through h, D^2, and h, and cut this part away. Allow a double edge around the outside of this pattern, and a single edge round the inside curve, similar allowances being made on the cone L. When making the case, bend the two halves of the cone N to shape, and then solder them together flush, soldering a strip of metal over the seam for strength. Prepare the cone L in the same way. Next throw off an equal flange on each cone and work an edge so that it will lap over the edge on the cone K, as shown in section by Fig. 7. Circular flat discs of metal are next cut, with holes in the centres equal to the diameters of the shafts, the outer diameters being ¼ in. greater than those of the ends of the cones L and N if the discs are to be soldered on; if they are to be knocked up, the allowance must be increased so that an edge could be taken up to fit over an edge thrown off round the cone. Cut these pieces in half before attaching them to their cones, and fix them with the cut across in line with the cone seams. Now solder the cone N to the cone L, as shown by Fig. 1. Bend the cones K and M to shape, wire them round the small ends, and throw off, square, a small edge round the large end. Unsolder the seams of the cones Z and N and run the solder off clean. Now make draw-wire fasteners, as shown by Fig. 4, for each seam on the cones, and rivet or solder them in position. When fitting the case over the wheels, first place the half cones soldered together in position, then place the top half of the cone L in position and secure it with the wire fastener, and attach the second half of the cone N in a similar manner. Now draw the cone M tight round the wheel and let it spring back into the edge on the N, and then fit the cone K into L, by the same method. A wire fastener slipped down the hinge on each side of the cones M and K along the radial line through D completes the case.

Impurities in Solution

Q.—We have been having difficulty with our nickel solution. The work has not been coming out well, as you can see from the sample we have sent you under separate cover, together with a sample of our solution. We trust you will analyze the solution and tell us what is wrong with it.

A.—Your solution analyzes as follows:

Nickel	3.04 ozs.
Chloride, as ammonium chloride	5.75 ozs.
Ammonium hydoxide	2.01 c.c.

While the solution is a little too acid and high in chloride content, this is not enough to cause the conditions shown on sample submitted. We have found that when analysis shows the solution to be right while the character of the deposit is as poor as on your sample, it is caused by the introduction into the solution of some impurity from improper cleansing and rinsing operations. The best way to overcome your trouble is to get some pieces of scrap metal or old racks, hang them on the cathode rod and work the solution for quite some time with the highest voltage possible. —OLIVER J. SIZELOVE.

Grinding of Metals and Alloys

The Norton Company, Worcester, Mass., manufacturers of a wide variety of abrasives, grinding machinery and allied products, give some interesting information on the use of their products for precision grinding of non-ferrous metals and alloys in their publication, "Grits and Grinds." This article, containing references to such of the company's products as Crystolon and Alundum of various grades, follows:

Probably the bulk of precision grinding in the non-ferrous field has been on pistons made of aluminum and aluminum alloys such as Lynite, Bohnite, Duralumin.

Because aluminum is a soft yet very tough meal it is most essential to use a wheel and work speed that will cut instead of tear the metal. The selection of a proper grain and grade of wheel is of equal importance.

The usual method used to finish pistons is to use a wheel about 2 in. wide, feed straight in at one end and removing from 0.00025 in. to 0.0005 in. per pass.

A good finish depends largely upon proper wheel speeds, plenty of good clean grinding compound and timely dressing of the grinding wheel. It is very important that the lubricant be strained to remove particles which might cause deep scratches in the work.

A very good cutting compound for this work is a mixture of kerosene and lard oil.

It has been our experience that very good results have been obtained with 46-J to 30-M Crystolon vitrified wheels, running at speeds varying from 5500 to 6000 s.f.p.m. and with work speed of 150-300 r.p.m.

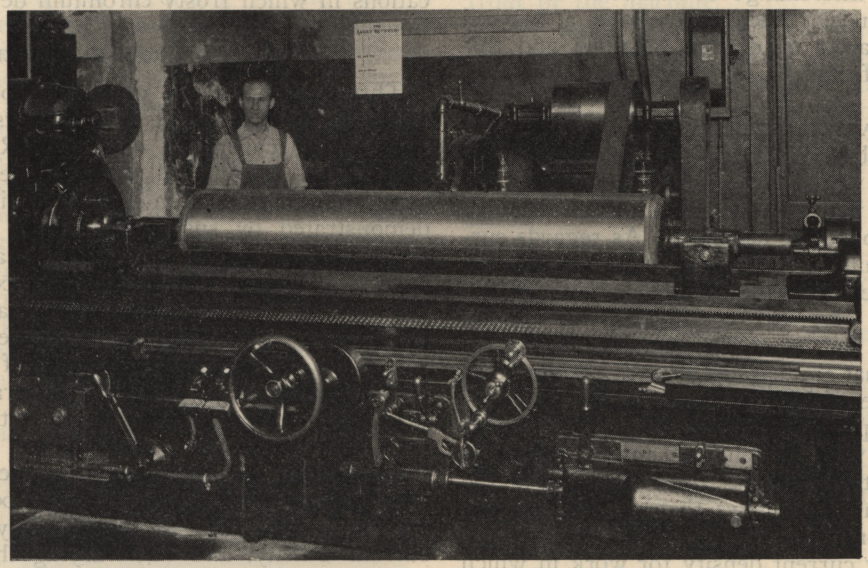
The medium high wheel speed and high work speed are necessary due to the soft nature of the alloy. Too slow speeds would result in small particles being pulled out rather than being cleanly cut.

Another common cylindrical grinding operation encountered on aluminum is the finishing of bushings. This is usually done on a universal machine or a lathe equipped with a tool post grinder. Small Crystolon wheels 6" or 8" x ½" grain 60 grade 2 or 3 shellac will give good results.

Internal grinding of aluminum is confined almost entirely to the grinding of bushings. Where possibly a lubricant should be used, the same compound used in piston grinding should be found very satisfactory. A grain 24 grade J Crystolon vitrified wheel will give very good results.

Surface grinding of aluminum would take in small castings and parts not covered by the previous notes. It can be done on a plain surface grinder or on one of the vertical spindle type. There are several factors which influence the wheel action, but in general the same grain and grade of wheels used on internal grinding will prove satisfactory, except on the vertical spindle type where a 3824 grade I Alundum silicate wheel is good for all around work.

Not very much can be said on precision grinding of brass alloys. The work is principally on small castings and odd pieces. Crystolon vitrified wheels ranging from 36 to 60 in grain size and grades J to L in hardness and selected according to finish desired should prove satisfactory. A wheel speed of 5000-6000 s.f.p.m. and work speeds varying from 150-300 r.p.m. with the use of a good lubricant kept clean by straining will give a good finish.



Grinding a Large Copper Cylinder

The grinding of bronze is practically the same as brass. Loading of wheel is one obstacle to be overcome and wet grinding should be used whenever possible. A medium high wheel and work speed will help overcome this condition. Wheels running at a speed of 4500-6000 s.f.p.m. and work speeds of 80-200 r.p.m. should prove satisfactory, wheels of grain 36 to 46 grades J to L should give a good finish under such conditions.

Very little precision grinding is done on copper except in the finishing of copper rolls. A few parts for commutators might be classified under this heading and for such work a 60-2½ Crystolon shellac wheel would do well.

Copper roll grinding is a very broad subject and much might be said of it. Copper is very difficult to grind satisfactorily. It has a tendency to tear apart instead of cutting clean. Wheel and work speeds are, therefore, a very important factor. For roll grinding a 100-I Crystolon vitrified wheel has given very good results.

Chromium Plating Fundamentals

A Discussion of Chromium Plating in All Its Aspects, Theoretical and Practical—Part 8*

By P. E. EDELMAN

Electrical Engineer

WRITTEN ESPECIALLY FOR BRASS WORLD

WHEN chromic acid (CrO_3) is prepared in a solution with water, as in the ordinary preparation of plating bath, a portion of dichromic acid ($H_2Cr_2O_7$) results and is present in the solution. Assuming that the usual buffer or sulphate content is now added and that the bath is subjected to electrolysis, the bath composition is thereafter changed during the electrolysis. In a short time the bath is quite different in composition from its starting condition. While the bath tends to reach a balanced composition for a period of electrolysis there are probable transient changes not yet fully understood but evidenced by the interchange of valencies on which electrodeposition depends. Such facts have a marked influence on the character of deposit obtained and this influence is further affected by the temperature and current density used.

SOFT AND HARD DEPOSITS

The difference in observed hardness of chromium deposits obtained under varied conditions is sometimes explained on the theory that different amounts of occluded gas (hydrogen) controlled the hardness. As regards current density, the amount of hydrogen made available in nascent state is greater with increasing current density. This corresponds to observed result that the softest chromium deposit is had when the current density is maintained low and that the hardest deposit results from the combined influence of high current density and correspondingly higher operating temperature. Since hardness is concerned also with the tendency toward cracks in the deposited metal, the hardness thus also affects the resistance to corrosion. It follows that a softer deposit should be more resistant to corrosion. This indicates the use of lower operating current density for work in which corrosion resistance is the principal desired characteristic. The premises further confirm the advantages obtainable from plural coatings previously discussed by the writer, thereby affording a softer prime coating immediately followed by a harder coating applied at higher current density. Such practice reduces the possibility of fissures and can afford both desirable characteristics, surface hardness and corrosion protection.

OPERATION FOR THICK AND THIN DEPOSITS

While serviceable thin deposits may be had under a range of operating conditions, thicker deposits are best had from operation at tapered current density. The increased thickness is then in reality continuously built up of layers of relatively softer electrodeposited metal applied at lower current density for a longer time and may be followed by a harder surface finished at higher current density. Hard deposits are readily obtainable from a concentrated bath solution containing as much as 35 per cent chromic acid content originally, operated at 45 degrees C. with high current density, but good deposits are then limited to a thin range, usually not over 0.00003 inch. A special application of plating in the preparation of chromium wire has been worked out by a series of replating operations. Increasing use of chromium deposits for mechanical service in contradistinction to finishing purposes will cause thicker deposits to be more commercial than at the present time.

EFFICIENCY

While bright plate necessitates low ampere-hour efficiency, such for example as 12 to 14 per cent in commercial practice, thick deposits requiring as much as 48 hours of plating time can advantageously be accomplished at higher efficiency range finally tapered down to the commercial bright plate range. There are some service applications in which frosty chromium deposits are not objectionable.

THROWING POWER

Throwing power is of first importance because the relatively poor throwing power limits the commercial application of chromium deposits. Recessed and irregularly shaped objects still present a serious problem in the application of chromium electrodeposition. This is readily demonstrated by suspending either a crinkled sheet of metal or one bent in the shape of a cylinder with ends open, as cathode. The cylinder for example may be nicely plated at its outer surface and remain entirely uncoated at its inner exposed surface. Wherever the current density is too low to cause reduction of the plating solution at the portion of the cathode concerned no metal can be deposited. Only portions of the cathode receiving sufficient current for this reduction will receive plated metal thrown from the solution so reduced. Attempts have been made to increase the throwing power by (1) increasing the conductivity of the electrolyte, (2) varying the current density, and (3) varying the electrode distance with respect to different portions of the dissimilarly contoured work cathode. The narrow plating range restricts these efforts to improve the throwing power in a chromic acid bath. Factors which can be varied in particular circumstances are (1) dilution of the bath, (2) increase of temperature and current density to secure the widest plating range permissible, (3) preparation of the base metal with a thin coat of metal such as copper which extends the plating range, and (4) use of pre-dips for same purpose as (3) on the work. Disposition of auxiliary anodes is a practical expedient to secure current distribution within plating range. Whereas other metals may be electrodeposited even at feeble current densities and over a wide range of current densities, electrodeposition from chromic acid baths requires a restricted range of current density and there is a minimum current density below which no deposit is obtained. Should some additional agent be found for the bath which will facilitate reduction of the plating solution at the cathode for deposition to extend the lower limit of the plating range, this would be a solution of the problem. But a chromic acid bath acts as a powerful oxidizing agent so attempts in such direction have not been successful.

It has also been proposed to agitate or move the plating solution with respect to the cathode work so that the solution adjacent to areas of the cathode receiving the

* Parts 1 to 7 were published in our issues for August to December, 1928, and January and February, 1929.

highest current density would be replaced faster than that adjacent to other portions. This might be done on special work, but ordinary agitation such as is afforded by usual conveyor systems is not effective for the intended purpose.

Some of the commercial samples in which the foregoing considerations have not been met, will be found to be coated on exterior portions but not at recessed portions, the only coating at the recesses being the underlying nickel coat applied to the base metal. At junction portions between the recessed worked and its exterior contoured surface, the line at which the cathode efficiency rapidly decreased below plating range can be observed. If work containing recessed surfaces is provided with a complementary screen or grid auxiliary anode spaced evenly therefrom, it can usually be coated satisfactorily. This is in effect a special form of mould plating, the anode being in fact contoured to correspond to the cathode work.

CRACKED DEPOSITS

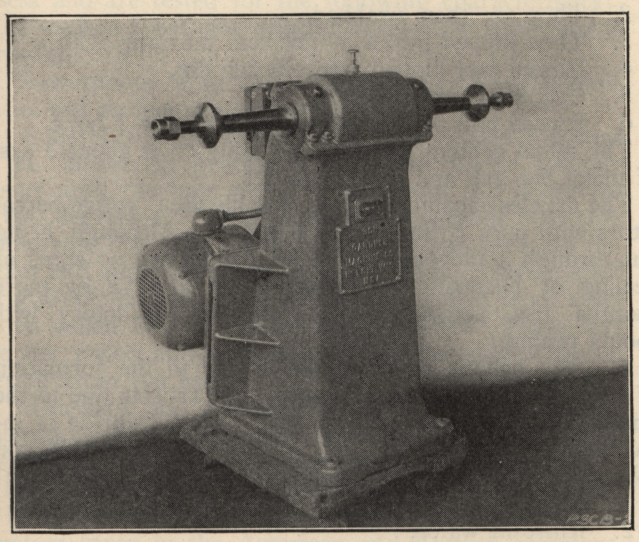
It has been observed that the occluded gas in electrodeposited chromium is not tightly locked therein. It may be liberated by heating. Voids observed in thicker layers of electrodeposited chromium may be caused by such liberation of partially locked-in gas during subsequent stages of the electrodeposition. Particles of deposited chromium are able to bridge very short gaps and interlock, but if the locked-in gas is liberated suddenly it is able to push through the junction of adjacent metal particles. A series of such tiny adjacent gas liberations seems to explain the growth of cracks. The presence of a network of cracks destroys the protective value of the deposit.

This series will be continued in an early issue.—Ed.

New Type Polishing Lathe

A new type of single spindle polishing lathe has been placed on the market by the Gardner Machine Company, Beloit, Wis., well known manufacturers of machinery. The new machine, known as the No. 3-CB, embodies a number of unique features, according to the makers. Among these are the use of an alternating current motor drive with the ability to maintain any desired spindle speed; the employment of a V-type multiple belt drive; exceptional rigidity and compactness of mechanism; and convenience of operation. In describing the driving mechanism of this machine, the manufacturers state that the spindle is driven by the V-type multiple belts, with a motor which is mounted on bracket. This bracket, they state, is an integral part of the base casting, and the design makes for an important saving in floor space. There is adquate means of adjusting belt lengths and for replacement of belts when necessary. Replacement, it is stated, can be made in a few minutes, and without disturbing the bearing mounting on the spindle. Further description is given by the company as follows:

The motor regularly furnished with this lathe is of



New Type Polishing Lathe

the enclosed, fan-cooled, ball bearing type, and can be supplied in 5, 7½ and 10 H.P. sizes. By using sheaves of proper diameter, any desired spindle speed may be obtained. This is of great advantage where alternating current only is available or is preferred. The spindle is large—2¼ in. bearing and 1¼ in. arbor diameter, to take polishing wheels up to 3½ in. thick. A double-row Timken adjustable bearing is used in each end, mounted in a thoroughly dust proof cartridge housing which may be removed from the base without disturbing the bearing mounting on the spindle—the entire spindle assembly can be removed as a unit.

The semi-projecting type of base, giving a slight overhang of the spindle, provides ample clearance across the front of the machine.

This lathe, it is stated, embodies all of the standard features which have always characterized Gardner construction. Safety spindle nuts, double-capped oil hole, handy push-button control station, convenient spindle locking device, and through-and-through massive machine-tool design, insure long life with minimum attention, even under severest operating conditions, the makers state.

Acid Resistant Cement

The U. S. Stoneware Company, 50 Church Street, New York City, manufacturers of a wide variety of stoneware products for handling acids, alkalis and other corrosive substances, has just placed on the market a new product in the form of an acid-proof cement which will be known as "U. S. Standard." This cement, the makers claim, is fully resistant to corrosion by acids, alkalis and other fluids or gases which are commonly considered to be corrosive agents, with the exception of hydrofluoric acid. These substances may be weak or strong, hot or cold, the company states.

The new cement is stated to be the result of several years of intensive research and development work in the company's laboratories. It was placed on the market only after very complete and repeated testing for the properties desired in such a substance.

The principal applications of this cement, according to the U. S. Stoneware Company, is in placing and repairing acid-proof tank linings, for Gay-Lussac and Glover towers used in manufacture of acids, for acid-proof floors, acid concentrators, acid-proof fan casings, etc. In electroplating plants it is useful in the construction of galvanizing and plating tanks, in fume and acid resisting linings and floors, in stacks and exhaust systems.

The company states that the cement contains 70.07 per cent of silica, which high content gives the cement very high refractory properties. The cement is pulverized to a very fine degree, permitting it to set in a dense, homogeneous body. The makers use special machinery in the manufacture of the cement in order to keep the impurities at an irreducible minimum. Production of this cement has been centralized at the company's plant No. 3 at Tallmadge, Ohio, where a battery of special machines has been installed.

Chromium Solution

Q.—We are making a large chromium-plating tank and before making the solution we would like to have your advice upon this and perhaps another point or two. It is for doing all sorts of work. The dimensions will be: 10′ long, 4′ deep (solution) and 3′ 7″ wide. What of those measurements for job work? The tank is made of wood and we intend to have it lead-lined with 2.5 m/m lead. Is that heavy enough? We intend to lay acid-proof tiles on the floor in case something heavy drops and would pierce the lead.

We want to make a good job of it; nothing cheap. If a ton extra of chromic-acid would improve the solution, we will do it. Since the technologic paper No. 346, other solutions have been made. Canning in Birmingham has 525 gram/Liter chromic acid and Langbein-Pfanhauser 500 gr./L. Mr. Sizelove in the BRASS WOLD of December recommends sulphuric acid .35 per cent of the chromic acid. Supposing our chromic acid of 99.5 per cent pure holds .2 per cent H_2SO_4, are we to mix in addition, say .35 per cent, sulphuric acid?

A.—A tank that is 10′ long, 4′ deep and 3′ 7″ wide, should be large enough for any ordinary job shop requirements and if lined with lead that is 2.5 m.m. in thickness, should be heavy enough.

Steel tanks that are lined with reinforced glass are now being used to good advantage in the United States.

The formula that was published in the December BRASS WORLD should have read .3 oz. sulphuric acid and not ".35 per cent of the chromic acid." When making solution, if the sulphate content of the chromic acid is known, this should be taken into consideration.

In general it has been found that a fairly high concentration of chromic acid allows the use of a lower current density and also increases the throwing power with a lower temperature.

The following formula is recommended:

Chromic acid	55 ozs.
Sulphuric acid	.5 oz. by weight
Water	1 gal.

Temperature 105° F., cathode current density, 75 amperes per square foot. The use of lead anodes or better still a 6 per cent antimony-lead alloy is preferable to the steel anodes as they prevent, to a certain extent, the formation of tri-valent chromium. The lead has a tendency to scale when in use, while the antimony lead alloy does not.

—OLIVER J. SIZELOVE.

Blue Chromium

Q.—My chromium deposit comes out bright but when it goes through the hot water and is dried it turns a bluish color. How can I prevent it?

A.—You do not state type of solution that is being used, neither do you state what the base metal is that receives the deposit.

Deposited chromium has a bluish cast and this is intensified somewhat if deposited upon copper, also, the lower the temperature at which the bath is operated the deposit is more blue. Believe that the bluish color that you refer to is a cloud in the deposit or on the work previous to chromium plating.

In drying work after being chromium plated, it is good practice to rinse thoroughly in clean cold water and then pass through an alkaline solution and then into clean hot water.

—OLIVER J. SIZELOVE.

Chromium for Jewelry

Q.—We will appreciate it very much if you will please accommodate us with the formula for a good chromium plating solution to be used for small articles in the jewelry line. Also advise us whether we will have to have outfits or machinery for the plating or can we plate by small batteries.

Do you have anything in a good formula for a crystal cement? We are grinding lots of crystals and have been having trouble with them coming out.

A.—To plate chromium you have to have a dynamo that will give about 100 amperes per square foot of cathode surface to be plated. For your information before you venture into chromium plating we would advise reading the following articles so that you may be informed on the technical points involved:

"Chromium Plating Fundamentals," P. E. Edelman, BRASS WORLD, August, 1928-February, 1929, inclusive.

"Notes on Chromium Plating," F. R. Porter, METAL INDUSTRY, September, 1927.

"Polishing and Buffing for Chromium Plating," Charles H. Eldridge, METAL INDUSTRY, June, 1928.

"Chromium Plated Jewelry," C. H. Proctor, METAL INDUSTRY, October, 1926.

The following is a good formula for chromium solution:

Chromic acid	60 ounces
Sulphuric acid	¼ ounce by weight
Water	1 gallon

Current density 75-100 amperes per square foot. Temperture 100°-110° F.

Silicate of soda commonly called water glass makes a very good crystal cement. —JOSEPH HAAS.

Nickel on Britannia

Q.—If possible would you kindly give what information you can about nickel peeling on pure Britannia metal. The following is a brief outline of the handling of the work:

1. The work is placed in an electric 12 volt cleaner for about 15 seconds,
2. They are then swabbed,
3. Then dipped into a 50 per cent muriatic acid,
4. Rinsed and dipped into cyanide dip,
5. Cyanide copper flashed,
6. Rinsed and placed into nickel tank for 1 hour.

The metal content of the nickel solution is about 3 ozs. of metal per gal. and the pH. is 6.1.

The articles causing the most trouble are: coffee percolators with pure Britannia metal spouts. Although, being put through a thorough inspection, there are no signs of peeling or blistering on spouts. But after 2 or more months' use, percolators are returned to factory with spouts peeling.

A.—We believe your trouble is due to the formation of lead chloride on the surface of your articles due to the immersion into cold muriatic acid. Lead chloride is insoluble in cold solutions, but soluble in warm. If you follow the following cycle you will have no more trouble:

1. Electric cleaner,
2. Rinse in water,
3. Immersion in warm muriatic acid (120° F.) 20 per cent,
4. Rinse in water and dip in hot potash cleaner.
5. Rinse in water,
6. Place on cathode rod in a cold sodium cyanide (4 ozs. per gal.) electric cleaner. Use steel anodes,
7. Copper cyanide flash,
8. Rinse and place in nickel tank.

—JOSEPH HAAS.

Progress in Nickel Plating

To The Editor of The Brass World:

WE receive and read with much interest your paper advising us of the work that is being done on your side.

In the issue dated January, 1929, there appears on page 11 a short article headed "Development in Electro Plating." This interests us particularly in view of the fact that quite half of the article is devoted to tests carried out on materials which have been deposited by the "FESCOL." Process and has apparently been taken from our Copyright Brochure No. 17, a copy of which we are enclosing with this letter.

We would refer you to pages 76, 85 and 86 which cover the tests dealt with in paragraphs 2, 3 and 4 of this article.

Naturally we are very pleased at the interest which is being taken in our Process in your country. We should however, have expected that in an article of this nature the usual acknowledgment or reference to the Process would have been made and we would ask you to be good enough to see that this acknowledgment is made at an early opportunity.

Fescol Ltd.
R. E. Wilson,
General Manager.

London, England
February 21, 1929

To The Editor of The Brass World:

I have your letter of the 8th, with enclosure. My article was based on the English and American technical literature, and the processes I had in mind when writing, were the English Fescol and the American Madsenell processes. The later is owned and controlled by the Madsenell Corporation, Portsmouth, Ohio. The Metals Protection Company, 1146 East 134th Street, Cleveland, Ohio, is a subsidiary of the parent company and constitutes the selling and operating agency for the process.

According to statements made, the Madsenell products possess and are tested for the following characteristics:

1. Freedom from pits, which indicate low resistance to corrosion.

2. Smoothness of surface. For instance, metallic globules on the surface are not present.

3. Adherence under bending and heat. Nickel deposited by the Madsenell process will adhere under bending stresses until the base metal breaks; and can be heated to 1000 degrees C. (1832 degrees F.) without blistering or otherwise affecting the bond. These two tests are important and apply to any thickness of plate. During 1927 over 200,000 lbs. of nickel sheets were rolled from sheet bars on which .070 inch nickel was deposited. These bars were hot rolled and without a single instance of nickel severing from the base.

4. Ductility and annealibility which will permit the combined plate and base to be drawn and rolled and stand annealing as frequently as these operations demand.

I may point out in this connection, that I have not had any brochures available, but have based my article on information given in the American and English literature. All I wanted to do was to give a short resume of the progress made in electroplating and results obtained without giving special reference to anybody.

In my mind there is little difference in the results obtained in the Fescol and the Madsenell processes. Progress has been made on both sides of the Atlantic, and I have tried to give equal attention to both these processes.

While the tests described in paragraph 2, 3 and 4 of the article deal with materials which have been deposited according to the Fescol method, I could (and I really should) have added test results obtained with Madsenell products. You will note by the last paragraph in the article and by statements 3 and 4 made above, that I also refer to results obtained in the Madsenell process. It is my opinion that tests described in paragraph 2, 3 and 4 of the article would give practically the same result with Madsenell products, and it is also my opinion that the Fescol products possess characteristics, very similar to those claimed for the Madsenell products.

If you are of the opinion that an acknowledgment or reference should be made to the Fescol Process, I would suggest that an acknowledgment or reference also should be made to the Madsenell Process.

In conclusion I want to state that ten U. S. Patents have been issued to the Madsenell Corporation during the years 1924 to 1927 and furthermore a number of foreign patents, among them the following Great Britain Patents: No. 142,432, No. 244,166, No. 244,167, and No. 248,797, all in 1924.

James Silberstein

Chicago, Ill.
March 11, 1929.

Black Nickel Solution

Q.—I am sending you a sample of a solution that I use for black nickel plating. I have found this satisfactory as far as production is concerned, but it does not produce exactly the black nickel finish I want. I would like it to produce a soft, dead block, rather than the dark steel color it now brings out. This solution is composed of arsenic, cyanide, double nickel salts, ammonium carbonate and water. I use nickel and sheet brass anodes. It works very well on either high or low current, producing work rapidly. The bulk of my work is to get an old iron finish on brass builders' hardware. This must be a smoky black on nickel before the final finish. I have tried adding copper carbonate and ammonia, without results.

A.—Your type of black nickel solution produces a grey black deposit due to the arsenic that is used in making the solution, A black nickel solution that will give a darker black is made as follows:

Double nickel salts	8 oz.
Ammonium sulphocyanide	2 oz.
Zinc sulphate	1 oz.
Water	1 gallon

Use solution at room temperature, with 1 volt pressure. If a smoky black is desired, add copper sulphate dissolved in water until the smut is heavy enough. Add the copper sulphate slowly, as the amount required is small and 5 or 6 ozs. should be enough for a 100 gallon solution.

—Oliver J. Sizelove.

Smut on Copper Anodes

Q.—I would like to know how I can improve my acid copper solution so that the rolled copper anodes that I use will not smut up over night. This has given me a great deal of trouble. I have a 240-gallon bath, containing 28 ozs. copper sulphite, 3 ozs. sulphuric acid, 66° and 1 oz. powdered alum. I plate with 1 volt current. The solution has been giving trouble in another way, too. It does not throw far enough, and I do not get a good plate on the far recesses of reflectors that I plate.

Q.—Indications of your trouble seems to be the low acid content of the solution. You can safely add 2 ozs. sulphuric acid per gallon. Make this addition and if trouble is not corrected, send us a sample of the solution for analysis. —Oliver J. Sizelove.

American Gold Leaf

AMERICAN chemists have not only learned the secrets of the Pharaohs but have improved upon them.

Gold leaf, as manufactured in America, is claimed to be vastly superior to the foreign product. An uneven texture and color are said to be discernible in the new foreign leaf whose secret manufacture was supposed to undercut American prices. These are some of the outstanding findings of a recent survey of gold leaf supplied to the high class hat trade undertaken by the control laboratory of the John B. Stetson Company, under the direction of Ivor Griffith, chief chemist.

Four thousand years ago, the Egyptians hammered gold in much the same way that it is beaten today, the chief difference being that they could not produce so thin a leaf. Their mummy cases are evidence of the Egyptians' skill in metallurgy, and figures indicate that gold in profusion was available in the time of Rameses II, the annual yield exceeding $35,000,000.

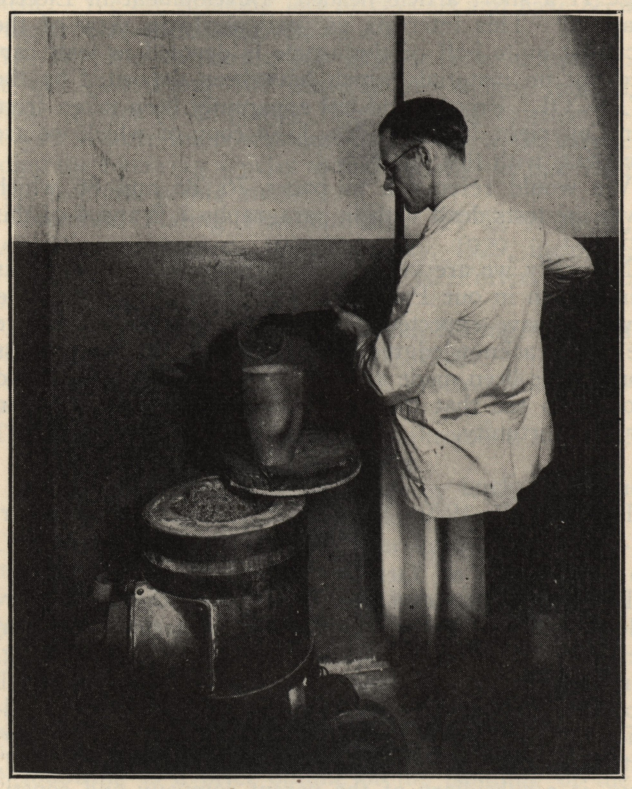
The Romans, too, were expert, Pliny reporting that "in my house a single ounce of gold admits of being beaten out into 750 leaves, four fingers in length by the same in breadth."

Sixteen hundred years later, Parisian metal workers were able to extend an ounce of gold over 105 square feet. The present advanced state of the art permits American workmen to extend one ounce over 200 square feet. In the process, the metal is reduced to almost microscopic thinness. If 280,000 gold leaves were placed one on top of the other, the pile would only be one inch thick.

Dr. Griffith undertook his survey to determine the best markets to purchase gold leaf for stamping dies or trademarks on hat leathers. He found that the standard process is to roll a 12 x 1 x ½ inch bar into a ribbon 525 feet long. After cutting this into one inch squares, the gold beater takes 150 pieces of gold which are interleaved with parchment paper. After this has been beaten for twenty minutes, each piece of gold is enlarged considerably. The 150 pieces are now quartered so that they become 600 pieces.

These are now interleaved with 600 pieces of "gold beater's skin," made from a delicate membrane of an ox. The beating process is repeated three times, the third process taking from four to five hours. In this way, five dollars in gold may be beaten out to cover 6,000 square inches of space.

Dr. Griffith inferred, because of the fibrous nature of



Pouring a Melt of Gold

our hand beaten product, as compared with the crystalline structure of some of the foreign importation, that the latter is electrolytically deposited leaf. This is evident from study of microphotographic plates of specimens.

Red and Green Gold

Q.—Will you please give me a formula for a bright orange-red-gold finish for glass rings? Also, a dark green (smut) finish that will stand a good washing?

A.—The best method of preparing a 14 karat gold solution is the porous pot method.

Sodium cyanide	4 ozs.
Phosphate soda	2 ozs.
Water	1 gal.

Heat solution to 180° F. and run gold in solution from 14 karat anode until solution contains 10 dwt. of gold per gallon. This can be determined by weighing the anode at intervals.

Another method of making a red gold solution is to add copper cyanide to the regular gold solution.

To prepare a dark green gold solution, add silver cyanide to the regular gold solution until desired color of green is obtained. When this has been accomplished, add a very small quantity of the smut solution which is made by dissolving 1 oz. of carbonate of lead in 4 ozs. of caustic soda. Agitation of work in solution hastens the formation of the smut. —OLIVER J. SIZELOVE.

Speed of Buffing Wheels

Q.—What are the best speeds for running a buff when polishing stainless steel and when polishing carbon steel? We use a good grade of green rouge.

A.—In polishing stainless steel a speed of 2,200 to 2,400 revolutions per minute for a 12 inch buff is considered the proper speed. The same should apply for carbon steel.

In polishing stainless steel, care should be taken to keep the wheel properly lubricated so as not to overheat the metal. When heated to 400° F., oxide of chromium is formed. This produces a stain or discoloration of the work which is very hard to remove.—OLIVER J. SIZELOVE.

Stripping Chromium

Q.—Can you send us a formula for stripping chromium off brass?

A.—Chromium can be readily stripped from brass by placing work in a hot hydrochloric acid dip. The stronger the acid the faster the deposit will be removed.

—OLIVER J. SIZELOVE.

Review of Progress in Nickel Plating

Interesting Paper and Discussion at Meeting of British Society

BY OUR LONDON CORRESPONDENT

WRITTEN ESPECIALLY FOR BRASS WORLD

A VERY interesting and instructive review of the progress of nickel deposition in recent years was given by D. J. Macnaughtan and R. A. F. Hammond of the Research Department, Woolwich, at the January Meeting of the Electroplaters' and Depositors' Technical Society. Following is an abridged version of their paper.

IMPROVEMENTS IN TECHNIQUE IN THE 20TH CENTURY INCREASING THE RATE OF DEPOSITION

With nickel ammonium solution operated at ordinary temperatures, it is not considered practicable to use a higher rate of deposition than about 5 amp. sq. ft. Using higher temperatures, it was found possible to increase the rate of deposition, but, owing to difficulties of heating on a large scale, this was not generally favored. A suitable solution that contained a higher nickel content was sought. By 1908 it was becoming increasingly common to replace a portion of the nickel ammonia sulphate by the more soluble nickel sulphate. This secured a moderate increase in the nickel content of the bath. A greater advance in this direction was obtained by the solution patented by Weston, containing nickel sulphate and boric acid. The relatively high solubility of nickel sulphate could be taken full advantage of. It was not, however, possible to use the high rates of deposition thus rendered practicable without improved anode corrosion. It had however, been pointed out by Bancroft, in 1906, that the addition of a relatively small amount of a soluble chloride, such as nickel or potassium or sodium chloride, would greatly improve anode corrosion. Solutions containing the three constituents, nickel sulphate, boric acid and a soluble chloride, thus came into use, and found increasing favor owing to the higher rates of deposition that were possible.

CONTROL OF THE SOLUTION. (1) ACIDITY.

The increasing departure from the traditional methods that had been in vogue since 1870 was followed by a demand for more careful control of the conditions of deposition, while as a result of the work of Sörensen and others, improved indicator methods for the determination of acidity had been greatly developed. Later, electrometric methods for the determination of the pH were improved, as a result of the introduction of the quinhydrone electrode, and were found to be more accurate than colorimetric tests.

The improvement in the methods for determining the pH of nickel depositing solutions led to more precise knowledge as to the most suitable range of acidity. The most satisfactory pH range in which to operate nickel solutions was recommended by various investigators as lying between pH 5.5. and 6.5.

It was found that the solutions of different compositions differ in the degree to which the pH is changed by additions of equal amounts of acid or alkali, and this degree of resistance to change into pH is commonly known as the "buffer characteristic" of the solution. A study of a variety of solutions by Blum and by Thompson showed that whereas a solution of nickel sulphate is almost unbuffered, the addition of a slightly dissociated acid such as boric, citric or acetic acid buffers the solution. The value of ammonium sulphate as a buffering constituent was shown later. The relatively unbuffered nickel sulphate solution is unsatisfactory for deposition, and it was established that all satisfactory nickel depositing solutions are at least moderately well buffered.

THROWING POWER

Up till 1922 very little work had been directed towards elucidating the fundamental principles which determine the manner in which a metal is distributed when deposited upon an article of complicated shape. In 1923 Blum and Haring analyzed the factors that influence the throwing power in copper depositing solutions and showed that the property was largely determined by (1) the rate of change of cathode potential with current density, (2) the conductivity of the solution, (3) the cathode efficiency at different current densities.

IMPURITIES

In the salts of nickel supplied to platers, impurities not infrequently present were copper, zinc and iron. A study of the influence of these impurities in the amounts likely to be present showed that copper tended to plate out in such a way as to give rise to rough nickel deposits, zinc to cause the production of bright and streaky nickel deposits, and iron to have an effect which was largely determined by the pH of the solution at low pH values, for example, it was found that iron is co-deposited with the nickel, whereas in the usual pH range, 5.5-6.5, it tends to become precipitated as hydroxide, which is liable to contaminate the deposit. Limits for these impurities in nickel sulphate were as follows:

Zinc not exceeding 0.5 per cent. Copper not exceeding 0.2 per cent. Iron not exceeding .1 per cent.

ANODE CORROSION

In solutions not containing chloride additions it is not possible to use nickel of high purity owing to the tendency of such anodes to become passive under ordinary conditions of deposition. The basis of the 1870 patent of Adams was the use of cast nickel anodes containing 6-10 per cent iron, which was assumed to be necessary to render the anodes soluble in the chloride free solution then used. Anodes containing this impurity together with carbon and frequently tin were in general use until recently.

In 1924 Thomas and Blum carried out plating trials with specially prepared sand cast and chill-cast nickel anodes of different compositions. They found that in solutions free from chlorides the solubility of a cast anode depends on the carbon content which for high solubility should be at least 1.4 per cent. This carbon is mostly present as graphite, and being distributed in a finer condition in sand-cast anodes these corrode in a more satisfactory manner than chill-cast anodes. Iron and tin did

not markedly improve anode corrosion, and as they added insoluble matter to the bath, were undesirable constituents. These investigators recommended for solutions free from chlorides the following specification for sand-cast anodes: Not less than 1.25 per cent carbon; not more than .25 per cent copper; not more than 1 per cent sulphur.

Further valuable contributions to practice were made by Hammond, Madsen and Hogaboom.

Another line of development in the manufacture of the purer types of anode consists in the introduction of a small proportion of nickel oxide into the nickel just before casting. The presence of the oxide favors corrosion. Anodes of this type are now being tried out on a large scale.

IMPROVEMENT IN THE QUALITY OF NICKEL DEPOSITS FOR PROTECTIVE PURPOSES

(a) Porosity and Pitting

The results of investigations upon porosity encouraged certain users of nickel plated steel articles to specify a minimum thickness of nickel of .001 in., and also to encourage the production of composite deposits of nickel and copper.

Pitting which has sometimes been confused with porosity, consists in the appearance of small crater-like depressions over the surface of the deposit. These depressions usually penetrate nearly, if not quite through the deposit, so that they cannot always be removed by buffing. It was early noted that these depressions were caused by the adhesion of gas bubbles to the surface of the cathode during deposition. Increase in thickness of the deposit was not a remedy, the pits frequently becoming enlarged during the progress of deposition.

In view of the general obscurity of the conditions that cause pitting a general investigation into the causes and prevention of the defect has been undertaken. In the first stage of this work it has been shown that pitting may arise not only as a result of a defective condition of the solution, but also as a result of imperfections in the basic metal. It has been found that an intermediate coating of copper of suitable thickness, such as had already been found effective in reducing porosity of deposits, serves also to decrease pitting due to defects on a steel surface. By the use of suitably prepared copper surfaces it is thus possible to restrict the study of pitting to the type that arises solely from a defective condition of the solution.

PEELING OR STRIPPING

The tendency of nickel deposits to strip spontaneously from the cathode frequently caused serious trouble in the early days of nickel plating. It was recognized that to counteract this tendency, greater care in cleaning prior to plating was essential than in the case of copper or silver. It was also found that the tendency to strip was more pronounced when the temperature of the solution was low, as it frequently was in the winter months. The phenomenon excited scientific interest. In 1877 Mills deposited nickel around the bulb of a thermometer, and found that a strong contractile strain was produced. In 1903 Johnson referred to the serious distortion of steel cathodes that could be caused by the stress in the deposit. In 1909 Stoney made some quantitative tests of the value of the stress by depositing nickel on one side only of steel strips, and calculating from the degree of bending produced the force of tension in the deposit. In deposits from a nickel ammonium sulphate solution, he found that the tension in the deposit might amount to as much as 18 tons per square inch. He found the stress could be roughly halved by raising the temperature from 15°C. to 85°C. From 1918 onwards the problem of stress in nickel deposits has received considerable attention from Kohlschütter, and his associates. They found that in a variety of solutions the stress was increased when the current density was increased, when the temperature was decreased.

Under practical conditions it has proved possible to decrease the stress by the use of increased temperature, but this has been partly offset by the use of increased current density. Increased purity of the anodes, and most careful control of the acidity has operated to prevent uncertain fluctuations in its value, but the most important development that has tended to decrease stripping has been secured by improvements in the method of preparation of the articles prior to deposition, which has secured a higher average degree of adhesion of the deposit.

ADHESION

The essential feature of the preparatory processes required to secure satisfactory adhesion of the deposit consists in removing from the surface of the article any foreign matter which, if left, would prevent intimate intermetallic contact between the deposit and the surface of the article. All traces of grease with associated dirt, and adhering oxide films must be removed.

After referring to recent developments in large scale production of Protective Nickel Deposits, the authors then dealt with The Production of Thick Deposits of Metal.

Within the recent years increased application of thick deposits of nickel have been developed. The most important of these appear to be (1) the repair by electro-depositing of worn or undersized metal parts, (2) the use of thick deposits of nickel for improving the resistance to wear and erosion of metal surfaces, (3) the production of electrotypes made entirely of deposited nickel, (4) the electro-forming of various nickel products, including tubes.

Greater difficulties have been encountered in the production with uniformity of suitable thick nickel deposits for the various purposes mentioned, than in the production of thin protective coatings. More exacting control of the conditions has been required to avoid the various defects liable to occur, and to secure deposits having suitable mechanical properties.

In general, for any particular conditions of deposition, the thicker the deposit the greater its stress, and the greater the tendency for peeling to occur. Much greater attention has therefore to be paid to the exact control of the depositing conditions (e.g., current density, temperature, pH and purity of materials) than is necessary in the case of thin deposits. In cases where stopping off, or electrotyping wares, are present, the temperature, in particular, has to be controlled within fairly close limits, in order to secure the benefit of a raised temperature in reducing the stress, and at the same time to avoid the danger of melting the wax.

STRUCTURE OF THE DEPOSIT

The Authors then discussed the microscopic examination of deposits of nickel, which show that the average crystal size of the harder type of deposit is distinctly smaller than that of the softer type of deposit. It has not however proved possible to establish that marked differences in cathode potential correspond to these differences in crystal structure. A factor which may greatly influence this relationship is the hydrogen which is discharged simultaneously with the nickel. Not merely does the inclusion of atomic hydrogen in the deposit affect its cathode potential, but it appears there is a possibility that its co-deposition in the deposit may influence its structure in some way, e.g. by interfering with crystal growth or by the formation of nickel hydrogen solid solutions. It is

also possible that the co-deposition of hydrogen with nickel has an important bearing upon the existence of stress in the deposit. On the other hand, the likelihood of co-deposited oxides interfering with the crystal growth and resulting in a refinement of the grain requires examination.

DISCUSSION

W. R. Barclay (Chairman) said that most technological arts commenced by being empirical, scientific methods being introduced at a later stage. In the progress of nickel deposition they had just entered the second stage which, however, was rapidly progressing after some 50 or 60 years of the first stage. In regard to the relative purity of cast and rolled anodes, this was connected with the discovery of malleable nickel, which was produced by adding a little magnesium or manganese. It could then be rolled, but such anodes were necessarily less pure than cast nickel. Under proper conditions of melting, such progress had now been made that it was now possible to obtain purer rolled anodes than cast anodes as previously prepared, this purity being about 99.6%.

E. A. Ollard said there were so many factors likely to upset the proper working of a nickel solution that the wonder was such solutions ever worked under shop conditions. It was probably due to a balancing of errors which were mutually compensatory. With regard to the suggestion that cathode potential influenced the throwing power, he thought that the actual nickel ion content of the solution had not been taken into account.

S. E. Weill recounted some experiences in Germany in 1870 when if one required a plating dynamo, it was necessary to build it oneself. There was much hit and miss in those days and as much bad work turned out as good. It was not until the chemist interested himself in plating problems that real progress was made; they could not be too thankful to the scientists for the work they had carried out.

L. Wright said the review which they had heard fulfilled a very useful function. It was evident that in spite of the smooth-running of plating shops, there were more problems than ever to investigate. A thorough knowledge of technique and not merely how to obtain a good finish was now necessary, for example, in handling very large work. In the case of an 18-ton article, they had plated the inside by using it as its own container. A knowledge of the purity of anodes, solutions and the physical constants of baths, etc., was as important as that of the electrical conditions.

W. T. Griffiths said undoubtedly a great deal of the scientific work on nickel deposition had been done in America, probably because they were inclined to spend more money on research while the problem of turning out large quantities of material was also important. The Society was to be congratulated in helping to get out information more readily now than was possible previously. With regard to purity of anodes, the American view was now that as high a purity as possible should now be used. Another important step was the introduction of automatic plating plant in cutting costs. The absence of the human factor made it possible to ensure that a definite thickness of coating was obtained by merely adjusting the mechanical conditions.

The authors then replied to the Discussion, after which they were accorded a hearty vote of thanks on the motion of the Chair.

Defective Copper Solution

Q.—We are using a copper solution made up as follows:

Water	1 gal.
Sodium cyanide	4 ozs.
Copper cyanide	3 ozs.
Caustic soda	½ oz.
Hyposulphite	1/32 oz.

We have a lead-lined tank with a lead heating coil. We plate small die castings in wire baskets, four loads per hour, about 2,000 pieces. The solution worked splendidly for about two months, then, in the last few days, it has been plating around the edges of the basket for a few minutes and stopping. The plate turns dark just before the deposition stops. We use the solution at a temperature of 100 to 140° F. We think lead has gotten into the solution. Do you think we can save the solution? We should like to save it as we have made up two new ones with the same formula.

A.—Indications point to a low free cyanide content. Add ½ oz. sodium cyanide per gallon of solution and if the trouble is not corrected, send a 2 oz. sample for analysis. We do not believe that the lead tank is the cause of the trouble, but would add no more caustic soda to solution. —Oliver J. Sizelove.

Bronze Finish on Screws

Q.—We enclose a few brass machine screws with a special bronze finish. We have tried to apply this finish, but do not appear to have the proper way of doing it. These screws must be plated in quantities at a very low price, and naturally we can only use the barrel plating. We understand, however, that a firm in the United States has been supplying these screws plated by the barrel process and is giving a very uniform finish, as you will notice from samples enclosed. If you have any information on this, we would appreciate hearing from you, as it means that we are now losing considerable business on account of not being able to give them a satisfactory plating on their screws.

A.—The bronze finish on sample screw has been produced as follows:

Cleansed from oil by tumbling in sawdust, followed by alkaline cleaning before plating in cyanide copper solution. After copper plating, rinsed thoroughly in clean cold water and bronzed in a solution made of yellow barium sulphide 2 oz., water 1 gallon. Use warm. They are then dried and tumbled in hardwood sawdust until desired shade is obtained. Finally, lacquer by placing them in an oblique barrel which is provided with an inside fine mesh wire screen.

Use the spray gun in lacquering. If you have a centrifugal dryer you can dip lacquer the screws in a basket and then place them in the centrifugal dryer.

—Oliver J. Sizelove.

Nickel for Chromium Work

Q.—Your articles on chromium plating have been of great interest to us.

We understand from your writers that a special nickel solution is advised. We should much appreciate it if you could inform us of the formula for making this special nickel bath.

A.—There is no special nickel solution that is used to deposit nickel preparatory to chromium plating. It is essential in chromium plating over a nickel deposit that the surface of the work be chemically clean and that the deposit of nickel be soft.

The most important factors in producing a soft nickel

deposit are purity of salts and anodes, control of the metal, acid and chloride content, temperature and current density.

The following solution is recommended:

Nickel ammonium sulphate	8 ozs.
Nickel sulphate	4 ozs.
Boric acid	2 ozs.
Ammonium chloride	2 ozs.
Water	1 gal.

Temperature, 120° F.; 12 to 15 amperes per sq. ft.; pH, 6 to 6.5. —OLIVER J. SIZELOVE.

Swedish Wrought Iron Finish

Q.—How can I produce the so-called Swedish wrought iron finish on cast iron articles

A.—To produce the Swedish iron finish on cast iron, follow this procedure:

All sand should be removed by using a hydrofluoric acid pickle, followed by a scratch brushing operation to procure a clean surface. Castings are then polished, using No. 80 emery followed with a No. 120 emery grease wheel. After castings are polished they should be thoroughly cleansed and lacquered.

Next prepare a paint by dissolving drop black in turpentine to the proper consistency and apply to the work. When partly dry, relieve with rag or felt moistened with turpentine and re-lacquer. "Metal Coloring" by A. H. Hiorns does not give this method but that is a valuable book on the coloring of metals and should be in every finisher's library. —OLIVER J. SIZELOVE.

Blisters on Copper and Nickel

Q.—I am sending samples of solutions that I have not had charge of very long. One is a cyanide copper solution and the other a nickel solution. I find that both of these tend to produce blistered deposits. I have tried adding cyanide to the copper solution but it has not done much good. The blisters appear after the work is left in the copper solution for about ten minutes. The nickel solution seems to be nice and white but it also shows a slight tendency to blister.

A.—Analysis of nickel solution:

Nickel	2.75 ozs.
Acid	4.53 c. c., pH 5.8
Chloride, as ammonium chloride...	1.20 ozs.

Solution is in fair condition and blistering of the nickel deposit is not due to the nickel solution. Look to the cleaning method. We are sure your trouble will be found there. We would advise adding 1 oz. of ammonium chloride to each gallon of solution.

Analysis of cyanide copper solution:

Copper	2.89 ozs.
Free cyanide	1.34 ozs.

Copper solution should be in good condition and here again we believe that the blistering of the deposit is due to improper methods of cleaning. It may be possible that your amperage is too high for a cold solution. Check this factor also. Cyanide copper solutions, when heated to 120° F., work much better than when used cold. The black coating on the copper anodes is due to the addition of hyposulphite of soda. Avoid an excess of this chemical as it causes a hard deposit. —OLIVER J. SIZELOVE.

Nickel on Die Castings

Q.—I have been having difficulty in getting bright nickel deposits on small, intricate castings that are rich in zinc. A considerable amount of the zinc gets into my plating solution. Is there a satisfactory method of getting a bright nickel deposit on such castings?

A.—We presume you are plating die cast metal. Satisfactory deposits of nickel can be obtained on die cast metal from the following solution:

Double nickel salts	10 ozs.
Sodium chloride	7 ozs.
Boric acid	2 ozs.
Sodium citrate	1 oz.
Water	1 gal.

The color of the nickel from this solution is white; a bright color is obtained by color buffing the deposit. If a bright deposit is desired direct from the bath, you might try adding to the bath a very small quantity of cadmium chloride.

When nickel solutions are used exclusively for die cast work they build up in zinc and there is no way, as far as we know, to remove it. It is customary to use as small a solution as possible and, when the zinc content gets so high that it is impossible to obtain satisfactory results, to discard the solution and make a new one.

—OLIVER J. SIZELOVE.

Plating Aluminum Alloys

Q.—Can you give us a formula for plating aluminum alloys to a gunmetal finish? Or can you give us the names of platers who do this work? We believe that plain aluminum cannot be plated, but we use a metal called duralumin and would like to know whether this can be plated satisfactorily or not.

A.—Aluminum and alloys of aluminum can now be successfully plated in any finish, due to the work done by Harold K. Work, Industrial Fellow of the Mellon Institute of Industrial Research, University of Pittsburgh. Mr. Work has developed a method whereby aluminum can be successfully nickel plated after which any other finish may be produced upon the deposit of nickel.

Why not try some of the job plating shops in your city? If they are not familiar with Mr. Work's methods, we are sure that he will assist them if they write to him.

—OLIVER J. SIZELOVE.

Apparatus for Salt Water Tests

The Industrial Filter and Pump Manufacturing Company, 361 Ontario Street, Chicago, Ill., makers of a wide variety of pumping and filtering machinery, has just placed on the market a type of apparatus designed particularly for use in making salt spray tests for corrosion of metals and metallic finishes, etc. The mechanism consists of a one-quarter horsepower motor, a bronze pump with fittings, a tank and a filter. The company states that it is a sturdy mechanism, designed with full knowledge of the work it is to do, and that it is fool-proof and practical in all aspects.

The tank supplied with the machine is made of tinned copper sheet and measures 18 by 35 inches. This is stated to be sufficiently large to give an adequate salt spray test to a good number of pieces at one time. Larger tanks can also be supplied on order. Nozzles and other fittings are of bronze. The apparatus is suitable for tests of 24, 48 or 72 hours' duration.

The makers state in connection with this mechanism, that every plating or finishing plant where quality work is produced should verify its results by corrosion tests. Salt spraying is an adequate as well as economical testing method, they state. The mechanism just placed on the market, it is stated, is less expensive to operate than systems requiring compressed air circulating outfits.

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What the Practical Man Knows

There was a time when the man in charge of a shop, the "practical" man, the man who "got out the work," was asked no questions. All the boss wanted was to see shipments move out fast.

Times have changed. The foreman is no longer the sole repository of facts handed down from generation to generation. He is a working part of a complicated organization and his status has changed almost completely.

He is a very much better informed and capable man than he used to be. He has no secrets. The chief may come down and ask him, not only what he is doing, but how he is doing it and why. And the foreman must know and be able to tell. He holds his place, not because he has some occult power, or because he works in the dark, but because he knows what he is doing, he can transmit that knowledge to his subordinates, making them better workmen, and can keep his superiors informed about the progress of his work.

The able plating foreman nowadays is a judge of the condition of the base metal upon which he is to plate; he knows the right type of cleaner to use; he mixes his solutions according to definite formulae and he knows polishing methods and materials. He understands the equipment, mechanical and electrical in his shop, and in addition, he is gaining a knowledge of chemistry to be able to test solutions for pH, make routine analyses and control his baths thereby.

The foundry foreman knows alloy mixtures and their properties. He knows melting and molding methods; he can differentiate between sands and he is familiar with various types of equipment, being able to tell which is best for any particular kind of work. In addition he is acquiring an understanding of metallography and can read a photomicrograph for practical purposes.

Is the foreman worse off for having lost his sole right to the "secrets" of the shop? He is not. Instead of being a close, clannish, peculiar person whom no one can understand and who is kept because he is feared, he is an upstanding, straight-talking member of the working family of executives. No one can take his knowledge from him. They can only give him more, which they do all the more willingly because he is glad to exchange.

Don't Miss These Meetings

Two important meetings are before electroplaters and foundrymen. The Research Committee of the American Electroplaters' Society will hold a conference on Saturday, April 6th, at the Elks' Club in Newark, N. J., together with the annual meeting and banquet of the Newark Branch. The American Foundrymen's Association in its meeting at Stevens' Hotel, Chicago, April 8-11, will feature non-ferrous metals.

Consider the following on plating: spotting out; chromium plating; analysis of cyanide solutions; measurements of pH; nickel plating; copper electrotyping solutions; iron deposition. Note the following on brass founding: non-ferrous foundry costs; practical brass foundry problems; open flame furnace for aluminum; electric arc furnaces in the jobbing brass foundry.

No topics could be more direct; no questions could be more practical than these. They come up almost daily in every plating shop and foundry. Old subjects? Perhaps. But there are new angles, new aspects, new troubles and new solutions every day.

The American Foundrymen's Association and the American Electroplaters' Society are to be congratulated upon the eminently practical and progressive character of their programs.

Questions and Answers

All inquiries are considered in the order received and the answers published in the next regular issue whenever possible

Black on Aluminum

Q.—We are endeavoring to secure a solution for obtaining a jet black finish on aluminum castings without the use of lacquers.

Is there any known plating process by which this finish may be obtained? If so kindly print same in your magazine.

A.—There is no chemical way that I know of whereby a jet black can be placed upon aluminum directly. The aluminum can be copper plated and the copper deposit blackened in a sulphur solution and then scratched brushed. You might try plating the aluminum direct in a black nickel solution.

—Oliver J. Sizelove.

Black on Zinc

Q.—Please send me a formula for a black coating upon galvanized (Zinced) iron.

A.—The following formulas will give a black coating upon galvanized sheet steel or iron.

The zinc surface should be cleansed before immersing in the oxidizing solutions.

Solution No. 1.

Water	1 gallon 160 deg. Fah.
Caustic soda	4 ounces
White antimony oxide	½ ounce

Mix thoroughly, immerse the galvanized steel in the solution for a minimum of seconds.

No. 2.

Water	1 gallon
Single nickel salts	8 ounces
Sal ammoniac	8 ounces
Boracic acid	2 ounces
Copper sulphate	¼ to ½ ounce

Temperature 110 deg. Fah. Time of immersion ten seconds.

No. 3.

Water	1 gallon
Nickel chloride	8 ounces
Sal ammoniac	8 ounces
Boracic acid	2 ounces
Copper sulphate	1/15 ounce

Temperature 80 to 100 deg. Fah. Time of immersion 2 to 3 minutes. After the black finish is produced upon the galvanized surface, then wash and dry and lacquer for protection.

—C. H. Proctor.

Cadmium vs. Zinc

Q.—Will you be good enough to furnish us with whatever information you have on hand regarding the relative merits of cadmium plating cast iron as against electro-galvanized cast iron or sherardized cast iron.

At the present time it has been standard practice to furnish the fittings of our manufacture, which are electrical wiring devices, in an electro galvanized finish to prevent the normal corrosive actions of outside weather conditions.

There has been a considerable tendency of recent to switch over to the cadmium finish for cast iron fittings that are used out-of-doors, but before taking this step we would appreciate very much any comments or information you can supply us with along these lines.

A.—Cadmium plated cast iron has a higher resistance to corrosion than electro-galvanized cast iron and the only factor against its use is the cost of cadmium. If cost is not to be considered, would recommend the use of cadmium.

—Oliver J. Sizelove.

Chromium on Brass

Q.—Having experienced considerable difficulty in depositing on our brass faucets a nickel plate that will properly hold an added film of chromium, we have for some time been depositing chromium directly on the polished brass successfully and have so far had no rejections or complaints. The disturbing information now comes to us that, because of the electrolytic action between the chromium and the zinc in the brass, the chromium plate will eventually crumble away or "dust off." We know that another manufacturer of brass goods is also depositing chromium on brass and without complaints.

Is there any evidence that this chromium-brass combination is not durable on plumbing fixtures or do you believe it necessary to deposit the intermediate covering of nickel?

We are sending you a sample of our present nickel solution for analysis.

A.—It is not advisable to deposit chromium directly upon an alloy in which the zinc is greater than 15 per cent for the chemical action that is produced will have a tendency to make the chromium deposit flake off. To produce a first class job of chromium plating on "high brass," it is necessary to deposit a good nickel plate, nickel color and plate in chromium solution.

Some trouble is encountered in doing so if the nickel solution is not kept to a standard. A soft nickel deposit is necessary and the factors that aid in producing a soft nickel deposit are purity of nickel salts and anodes, temperature, and control of the pH.

The following solution will give excellent results:

Double nickel salts	8 ozs.
Single nickel salts	4 ozs.
Ammonium chloride	2 ozs.
Boric acid	2 ozs.
Water	1 gal.
Use solution at 100° F.	pH. 6 to 6.2

Analysis of present nickel solution:

Metallic nickel	1.30 ozs.
Chloride as ammonium chloride	1.98 ozs.
pH.	5.6

Solution is low in metal and also the pH. is too low to produce a soft nickel deposit which is necessary if chromium is to be deposited upon the nickel deposit.

The addition of 2.2 ozs. of nickel sulphate will increase the metal content of the solution to 2 ozs. of metallic nickel per gallon and the addition of 1 cubic centimeter of ammonium hydroxide 26° to each gallon of solution will raise the pH. to 6.

Would also recommend a temperature of 100° F.

If after making the suggested additions to your nickel solution the deposit of nickel still raises, strike the brass work in a warm cyanide copper solution for a few seconds before nickel plating.

—Oliver J. Sizelove.

Chromium on Dies

Q.—Will a reduced chromium solution give a better wearing surface to dies than a hexavalent chromium?

A.—In chromium plating dies or other surfaces for wear where hardness of the chromium deposit is the main factor to be considered, would suggest the following solution:

Chromic acid	33 oz.
Sulphuric acid	.3 oz. by weight
Water	1 gallon

Temperature 110°—115°F. Cathode current density 125 to 150 amperes per sq. ft.

The factors that produce a hard deposit are high temperature and cathode current density, but when these are high the throwing power of the solution is reduced.

—Oiver J. Sizelove.

Copper Solutions

Q.—I am mailing you today samples of two copper solutions which I would like to have you analyze for me. Please let me know copper content, cyanide and the amount of carbonates that have formed; please give me the analysis in "oz. per gal."

I have had a great deal of trouble with the anodes coating over. The water here has an enormous amount of iron. Do you think it would have any effect on the anodes?

A.—Analysis of cyanide copper solutions, per gallon:

No. 1:

Metallic copper	3.18 ozs.
Free cyanide	1.04 ozs.
Sodium carbonate	6.13 ozs.

No. 2:

Metallic copper	3.30 ozs.
Free cyanide	.78 oz.
Sodium carbonate	5.36 ozs.

Analysis shows solution to be in good working condition. No. 2 is a little low in free cyanide. Add ¼ oz. of sodium cyanide to each gallon of solution.

Do not believe that the iron that is contained in the water is the cause of the anodes coating over, but it is due to an excess of hyposulphite of soda which is used as a brightener.

—Oliver J. Sizelove.

Faulty Nickel Solution

Q.—We sent you under separate cover 2 oz. nickel solution and wonder if you can tell us what is the matter with it. We have done everything we know and would like to know if it is worth while to save same or throw it out. It is a 400 gal. moving cathode tank.

A.—Analysis of nickel solution:

Metallic nickel	2.35 oz.
Chloride as Ammonium chloride,	2.84 oz.
P. H.	6.2

From the above analysis your solution should be a good working solution. You do not state what your trouble is, but surmise that the deposit is raising and if so, believe that the trouble lies with the temperature of the nickel solution or in the method of cleansing the work. See that the temperature of the nickel solution is raised to 80°F.; check cleansing methods and advise further.

—Oliver J. Sizelove.

Finishing Solutions

Q.—I am sending you two solutions which I would like to have analyzed. One is a pewter finish and the other is a stain finish.

A.—The solution that produces a stain finish is ammonium sulphide and the one that produces a pewter finish is a tin solution that contains 8 oz. sodium hydroxide and 2 oz. stammons chloride; water 1 gallon.

—Oliver J. Sizelove.

Gold on Nickel Silver

Q.—I have to gold plate German silver pocketbook frames. Please give me full directions.

A.—The salt water gold process is generally used for your class of work as it is cheap and a good uniform color is obtained. German silver is a little more difficult to clean than brass and to obtain a clear deposit of gold, so it is customary to plate in a nickel solution for a few minutes, then plate in brass solution for a nice green color before gold plating.

Any of the prepared cleaners that contain a little rosin are preferable for cleaning German silver.

The salt water gold unit consists of a porous pot which is surrounded by a cylinder of zinc and placed in salt solution made up to 12° to 15° Bé.

These units can be purchased ready for use.

Formula for salt water gold:

Yellow Prussiate potash	12 ozs.
Carbonate soda	6 ozs.
Phosphate soda	3 ozs.
Sulphite soda	1½ ozs.
Water	1 gal.
Gold as fulminate	4 pwt.

—Oliver J. Sizelove.

Heat-Resisting Nickel

Q.—Due to the construction of our product we force a large quantity of heat at a high temperature through a small space, and we are experiencing trouble in our nickel plated line, in that the casting at the point of exit of this heat becomes blackened in a very short length of time.

We have never measured the temperature at this exit,

but it will melt wire solder very quickly, and we estimate that it is around 500° F.

We thought possibly that you might be able to assist us by advising some way to improve our nickel plating at this particular point, or that you might suggest some other plating that would harmonize with the nickel plating on the other part of our casting.

A.—500° F. is quite a high temperature to subject a nickel deposit to. Believe that this temperature will tarnish any nickel deposit when this degree of heat is used continuously.

It is a known fact that a deposit of nickel that contains a small percentage of iron will tarnish more readily than one without iron so you can possibly prolong the time that it takes to tarnish by eliminating the iron in the deposit.

Chromium would be the most suitable metal to deposit on your line of work as this metal has the highest resistance to tarnish of any of the deposited metals, although at 500° F. a discoloration is produced.

—Oliver J. Sizelove.

Hot Zincing

Q.—We have recently installed a small hot-dip galvanizing furnace suitable for hot-dipping tacks and nails in wire baskets.

Owing to our lack of knowledge in regard to the heat of the metal, and as to the proper flux, we are continually running into difficulty. For example: the work is eithe not properly coated, or it has too great a coat, causing it to appear lumpy.

We have been advised that a pyrometer, although not required, would be a help to us, and we are contemplating the installation of one.

May we have your opinions and any knowledge you can give us in regard to the hot-dipping process of galvanizing tacks and small nails?

A.—The temperature for successful uniform results in hot galvanizing tacks and nails should range from 875 to 890 deg. F. An experienced hot galvanizer can determine molten zinc temperatures very closely, but with the aid of a pyrometer there is no guesswork, so uniform results can be constantly obtained if the correct methods of cleansing and fluxing the product to be galvanized has been carried out.

The flux for your product should consist of equal proportions of muriatic acid and water to each gallon of acid and water; add one pound of granular sal ammoniac. The product should be well drained and partly dry before immersing in the molten zinc. Cool afterwards in hot water.

—C. H. Proctor.

Imitation Aluminum

Q.—We have a proposition on hand which involves the use of tubing to be plated and polished the same color as polished aluminum, and would appreciate it very much if you could give us some information on this.

A.—We believe your best purposes would be answered by the use of a cadmium solution. Make up the following solution.

Cadmium cyanide	5 ounces
Sodium cyanide	6 ounces
Sodium hydroxide	1 ounce

Use cadmium anodes held in a steel framework using 8-10 amperes per square foot. Plate 20-30 minutes and then color very lightly with a buffing wheel.

—Joseph Haas.

Nickel on Die Castings

Q.—What is a good nickel solution for die castings?

A.—If you take the precaution not to discolor your die-castings with too strong a cleaner, you can by having the current on the tank and keeping it in the vicinity of 25-35 amperes per square foot, plate die castings with the following solution:

Nickel sulphate	32 ounces
Sodium sulphate	16 ounces
Sodium citrate	8 ounces
Boric acid	4 ounces
Water	1 gallon

Keep the temperature of the solution, particularly in winter, at 70 deg. F. Temperature in summer should not exceed 90 deg. F.

—Joseph Haas.

Rose Gold Finish

Q.—We are enclosing a sample ornament showing a special finish which we are anxious to duplicate. Can you tell us how we might go about obtaining this finish?

A.—The finish is rose gold. Sand blast copper plate in an acid copper solution. Bright dip, then gold plate in an old (one that has been used a long time) gold solution. Aged bold solutions have the property of depositing with a brown smut like the sample. If no old gold solution is available, make up a gold solution of 1½-2 dwt. of gold per gallon and add 6-8 ounces of sodium carbonate. This will aid in giving a smut, although not as good as an old solution.

If the smut is too light add a few drops of cyanide of copper solution which will darken the smut.

After the smut gold is deposited, the high lights are relieved with the fingers with damp bicarbonate of soda. Rinse and dry. Then hand burnish the high lights.

—Joseph Haas.

Sand Tumbling

Q.—Can you give us information on sand tumbling bronze castings? These castings are fairly smooth and must be polished. We understand that there is a sand tumbling operation which brightens and smooths the surface and which is of great assistance in the polishing operation.

A.—You can remove the roughness from your bronze castings by tumbling them in a horizontal iron barrel using sand and water as the abrasive. The longer they are tumbled, the smoother the finish obtained. These barrels can be purchased through advertisers in The Brass World.

—Oliver J. Sizelove.

Tin Solution

Q.—We have your letter of Feb. 7th enclosing formula for tin plating solution.

We note that the first item calls for 28 ozs. of Sodium Stannate and the last item calls for 1 gal. water.

Will you kindly advise if this is the correct quantity on the first item as it seems to us a large amount to use with only 1 gal. water?

A.—The formula for tin solution calling for 28 oz. sodium stannate per gallon is correct. There will be an excess of this salt that is not soluble, but the formula as given is correct and if made accordingly, good results will be obtained.

—Oliver J. Sizelove.

Associations and Societies

American Foundrymen's Association

The Program of the 1929 Convention of the American Foundrymen's Association

The convention sessions of the 33rd annual meeting of the American Foundrymen's Association will be held in the meeting rooms on the third floor of the Stevens Hotel, Chicago, during the week of April 8th, while the exhibits of foundry equipment and supplies will be shown in the Exhibit Hall of the same building. The splendid meeting rooms, conveniently adjacent to the exhibits, will provide an excellent setting for the well balanced program which the Committee on program and papers has arranged.

The make-up of the sessions has been planned to provide discussions of interest to all groups of foundrymen, the executive, metallurgist, engineer and shop man. Furthermore, one who is interested in any special branch of the industry such as non-ferrous foundry practice, will, by consulting the schedule of sessions, be able to plan to stay at the convention for the days when subjects of particular interest to him are discussed.

SCHEDULE OF METAL PAPERS AND DISCUSSIONS

Foreman Training. The symposium on foreman training should be of the greatest interest to executives of foundries for the men who will speak at this meeting have had wide experience in training work and in planning foreman training courses. Without doubt, there has seldom been at past conventions a session which has brought together such an imposing array of speakers as this meeting will when Mr. Pierce, Director of Industrial Education of the National Metal Trades Association; Mr. Hartley, Educational Director, National Founders Association; Mr. McGarvey of the Federal Board for Vocational Education; Mr. Lynch, Personnel Director, of the Ohio Brass Company; Mr. Mullen, Supervisor of Education, West Lynn Plant of the General Electric Company, and Mr. Coleman of the W. A. Jones Foundry and Machine Company, discuss foreman training.

Apprentice Training. Following out recommendations received by the Apprentice Committee, the apprentice session will be devoted to the Why and the How of foundry apprenticeship. J. A. Davies, General Superintendent of the South Philadelphia Works of the Westinghouse Electric and Manufacturing Company, will tell Why he believes in training and A. M. Cornell, Vice President of the Pettibone-Mulliken Company, will describe how his organization trains their foundry apprentices.

Illustrative of the interest in foundry training, foundries from the following cities will have patterns and castings entered in the annual apprentice pattern making and molding contests: Milwaukee, Wis.; Schenectady, N. Y.; Davenport, Iowa; Moline, Ill.; Providence, R. I.; West Lynn, Mass.; Philadelphia, Pa.; Baltimore, Md.; Chicago, East Chicago, and Harvey, Ill. Apprentices from approximately fifty foundries will take part in the preliminary contests.

Foundry Costs. E. T. Runge of Cleveland will address the first meeting on foundry costs, discussing costs from the viewpoint of the medium and small foundry operator. Following this session, an informal meeting of non-ferrous foundry operators will be held to discuss ways and means of forming local groups to use uniform methods of cost accounting.

Foundry Sands. The foundry sand control meeting will be divided into two sections. The first section will be devoted to the fundamentals of installing sand control methods. Short talks will be given by men who have had practical experience along this line. This meeting will be followed by a dinner gathering, after which the second section will be held. At this time reports of the A. F. A. committees will be read, a talk on sand handling and conditioning equipment will be presented, and two papers on technical sand control will be read and discussed.

Materials Handling. Materials Handling, which is of increasing importance to foundry executives and engineers, will be the subject of a special session. Two important papers will be presented, giving data on comparative costs of handling materials.

Non-Ferrous Foundry Practice. In addition to the general interest sessions already mentioned, the non-ferrous foundryman will be especially interested in the round table luncheon meeting on brass, bronze, and aluminum shop problems, and a technical session devoted to non-ferrous metallurgy and shop practice. Melting furnaces will be discussed in two of the papers at the latter session. J. W. Bolton of the Lunkenheimer Company, who is Chairman of the A. F. A. Division on Non-Ferrous Foundry Practice, will report on the past and proposed activities of the A. F. A in the interest of the non-ferrous casting industry.

Tuesday, April 9

12:30 P.M.

(a) Round Table Luncheon and Meeting: Uniform Non-Ferrous Cost Methods. Chairman, E. B. Hazen.

Wednesday, April 10

10:00 A.M.

(a) Non-Ferrous Foundry Practice.
Chairman, G. H. Clamer.
Some Practical Problems in the Brass Foundry, by H. J. Roast, National Bronze Company, Ltd., Montreal, Quebec, Canada.
An Open-Flame Hearth-Type Furnace for Melting Aluminum and Its Alloys, by R. J. Anderson, G. E. Hughes, and M. B. Anderson, Fairmont Manufacturing Company, Fairmont, W. Va.
Electric Arc Furnaces in General Jobbing Brass Foundry, by J. B. Meier, F. & H. Foundry Company, Newark, N. J.
Report of Chairman of Division of Non-Ferrous Foundry Practice.

12:30 P.M.

Round Table Luncheon and Meeting: Non-Ferrous Shop Practice. Chairman, J. W. Bolton.

American Electroplaters' Society

Bridgeport Branch

HEADQUARTERS, CARE OF WILLIAM EHRENCHRONA, 872 HANCOCK AVENUE, BRIDGEPORT, CONN.

The Bridgeport Branch of the American Electro-Platers' Society will hold the annual banquet at the Stratfield Hotel on April 27, 1929. The Educational Session, which will take place at two thirty, will include **Horace Smith,** President, who will speak on the aims of the Society; **Carl Pitchner,** on Buffer Properties of the Nickel Plating Bath; **George B. Hogaboom** will conduct the very popular question box; **Dr. L. C. Pan,** on Simplified Methods of Chemical Control.

Chicago Branch

HEADQUARTERS, CARE OF S. J. C. TRAPP, 1127 NORTH 7th STREET, MAYWOOD, ILLINOIS

A very successful annual session and banquet was held by the Chicago Branch, American Electroplaters' Society, January 26, 1929. There were 325 persons at the session, which was presided over by Oscar E. Servis, librarian of the Branch. Robert Meyers, president of the Branch, welcomed everyone in the opening address, after which the following papers were delivered:

Program, Educational Session

The Future of Chromium, by Professor Edwin M. Baker, of the University of Michigan. This paper was illustrated with lantern slides and charts, and gave the results of tests of a great variety of chromium deposits, showing the thicknesses, durability, usefulness and appearance of the various plates tested. He concluded by declaring that the future of this field of plating depends to a large extent upon the quality of the chromium deposits produced on goods used by the public. In discussion following the paper he stated that a "good" chromium deposit is one that is rust-resisting to weather for 1½ years, or to rubbing and washing for 3 years. Such a deposit requires from 300 to 600 ampere minutes. A chromium deposit directly on brass is not economically satisfactory, he said, because it will not resist wet weather, although in dry weather it might be satisfactory. Asked whether this applied to red as well as to yellow brass, he said that deposits direct on yellow brass are poor, on red brass intermediate and on copper very good. He stated that a nickel strike is preferable to a copper strike on brass before chromium plating, but that a nickel flash is difficult to put on yellow brass if adherence is needed.

Modern Methods of Tin Deposition, by Charles H. Proctor, founder of the Society and plating editor of THE METAL INDUSTRY, was the next paper. Mr. Proctor's paper was found highly interesting, as were some exhibits of tin deposits which he handed around.

Impromptu Remarks on Chromium Plating, by Erwin Sohn, research director of the Standard Sanitary Company, Pittsburgh, the next paper, gave a number of excellent suggestions and brought out the point that an excessively high sulphate content in a chromium bath wastes current and makes for poor, cracked deposits.

The Theory of Chromium Plating was discussed by Oliver P. Watts of Wisconsin University. He gave many valuable points and touched upon the practical application of the theory. He mentioned the use of hydrochloric acid with 2 per cent of formalin by volume for stripping chromium plate from steel. Another interesting point was mention of the old nickel "doctor" in connection with chromium work. He suggested wrapping the lead anode with asbestos cord, and that work being "touched up" be kept warm.

The Truth About Chromium was a paper read by Jacob Hay, of the C. M. Hall Lamp Company, Detroit.

Considerable discussion of various phases of chromium work followed the papers.

Milwaukee Branch

HEADQUARTERS, CARE OF J. N. HOCK, 1229 WEST 24th STREET, MILWAUKEE, WIS.

Annual Session and Banquet

The Milwaukee Branch of the American Electroplaters' Society will hold its annual educational session and banquet on Saturday, April 6, at the Schroeder Hotel, Milwaukee.

The session will begin promptly at 2:30 p. m., and the banquet at 7:00 p. m. The latter will take place in the Green Room and there will be entertainment and dancing after the dinner. The following papers are to be presented at the session:

Chromium Plating—A New Lease of Life for the Plater, by N. De Cesare.

Modern Lacquers, by E. H. Bucy.

Is a Small Amount of Iron Detrimental or Beneficial in a Chromium Solution? by Charles H. Proctor.

Troubles of a Chromium Plater, by R. F. MacGuire.

Overcoming Spotting Out on Plated Articles, by R. J. Hazucha, Maas and Waldstein Company, Newark, N. J.

Discussion will follow the papers and all platers, chemists and plant executives in the Milwaukee district are urged to come and get the benefit of this important session.

Newark Branch

HEADQUARTERS, CARE OF R. F. CLARK, BOX 201, NEWARK, N. J.

All-Day Session—Annual Banquet

On Saturday, April 9, 1929, the annual educational session, followed by the annual banquet, of the Newark Branch of the American Electroplaters' Society will take place at the Elk's Club, Newark. The session this year will be unique in that a whole day will be devoted to a great variety of electroplating subjects. The meeting is expected to be one of the greatest in the annals of the Society. The day will be given over to a conference of the Research Committee of the American Electroplaters' Society, which in the past has taken place at Washington, at the United States Bureau of Standards. This year it will be held at Newark in order to make it more convenient for a greater number of platers and chemists to attend. The purpose of the conference is to receive reports on the work done by the Society's research associates who have been at work at the Bureau of Standards solving many problems in electroplating, in collaboration with the Bureau's research

men. There will also be a report by the treasurer of the Research Committee and suggestions and plans for future work will be outlined. The following tentative program has been arranged for the conference:

Research Conference, April 6

Morning Session, 9 A. M.

Spotting Out:

W. P. Barrows, Research Associate, American Electroplaters' Society.

Chromium Plating:

W. Blum, Bureau of Standards: "Outline of Chromium Researches At Bureau of Standards."

H. R. Moore, Bureau of Standards: "Conductivity of Chromic Acid Solutions."

H. L. Farber, Research Associate, American Electroplaters' Society: "Throwing Power in Chromium Plating."

General discussion of chromium plating problem.

Analysis of Cyanide Plating Solutions:

M. R. Thompson, Bureau of Standards.

Afternoon Session, 2:00 P.M.—5:00 P.M.

R. J. O'Connor, Chairman, Research Committee, Presiding

Measurement of pH in Nickel Plating Solutions:

W. Blum, "Outline of the Investigation." Statement of Results by: N. Bekkedahl, Bureau of Standards; K. Pitschner, American Chain Company; C. J. Rosecranz, Leeds and Northrup; F. R. McCrumb, LaMotte Chemical Products Company; A. K. Graham, University of Pennsylvania; J. T. Burt-Gerrans, University of Toronto. Summary of pH.

General Discussion of Nickel Plating problems.

Addition Agents in Copper Electrotyping Solutions:

R. O. Hull, Research Associate, International Association of Electrotypers.

Iron Deposition:

C. T. Thomas—Bureau of Engraving and Printing.

Future Plans.

All persons interested in the above subjects or work are invited to be present in person or by representatives.

The banquet will take place in the evening. As usual, this will be a brilliant affair, and all the platers at the session and any others who care to attend are cordially invited to make reservations as early as possible by communicating with the secretary at the address given at the head of this notice. Those who are coming to attend the sessions and wish to reserve sleeping accommodations can do so by communicating at once with H. H. Smith, 208 North Third Street, Newark, N. J., stating full details as to number in party, ladies, etc.

Rochester Branch

HEADQUARTERS, CARE OF C. GRIFFIN, 24 GARSON AVENUE, ROCHESTER

Annual Session and Banquet

The annual banquet and open meeting of the Rochester Branch, A. E. S., will be held April 13th, 1929, at Powers Hotel, Rochester. The committee in charge of arrangements composed of Charles Griffin, William Hart, S. P. Gartland, Raymond Lopez, Clarence Reama, and John Snyder, promise that this will be one of the best sessions ever held. All platers in the neighborhood are invited and urged to attend.

The open meeting will begin at 3:00 P. M., and the banquet at 6:30. Music for dancing after the banquet will be provided for Eli J. Beaudry.

Personals

J. L. Patterson is now manager of the Buffalo plant of the United States Aluminum Company.

Mont Murray recently became affiliated with the General Bronze Company of Pittsburgh, as chairman of the board of directors. Mr. Murray was formerly president of the Keystone Bronze Company, Pittsburgh.

Clifford Hubbell has been added to the directorate of the Lumen Bearing Company, Buffalo, brass and bronze casting manufacturer, succeeding the late Samuel Ellis.

H. J. Stein is now connected with the Allis-Chalmers Manufacturing Company, West Allis, Wis., having recently resigned his position with the Ornamental Brass Shops, Rockford, Ill.

Clarence E. Mange, president, Missouri Chromium Plating Company, St. Louis, Mo., spoke on chromium plating at a meeting of the St. Louis chapter of the American Society for Steel Treating, on February 15th.

H. D. Wilkinson is now a representative for the Liquid Metal Products Company, Chicago, Ill., producer and distributor of Stibloy, a rust-resisting coating for zinc products. He was formerly in the publishing field.

J. E. Watson and **J. I. Thompson** have been elected directors of the Pittsburgh Die Casting Corporation. Mr. Watson also has been named secretary of the corporation. He is vice-president and general manager of the Elliott Company, Jeannette, Pa., and Mr. Thompson is a vice-president of the Koppers Company, Pittsburgh.

O. B. Wilson has been placed in charge of the Brown Instrument Company's Cleveland office at 819 Hippodrome Building. His previous identification with the Brown organization has been in the New York and Philadelphia offices.

George B. Hogaboom, chemist for the Hanson-Van Winkle-Munning Company, Matawan, N. J., gave an illustrated talk on the "Crystal Growth of Metals," at a meeting of the Worcester, Mass., chapter of the American Society for Steel Treating, held at Rebboli's Restaurant, 10 Barton Place, on Thursday evening, March 7th.

H. P. Ackerman has organized a manufacturers' agency to be known as the Steam Specialty Sales Company, with headquarters at 908 W. Trade Street, Charlotte, N. C. The company will handle a complete line of Homestead valves in North and South Carolina and a part of Georgia. Mr. Ackerman has been Eastern district sales manager for the Homestead Valve Manufacturing Company, Coraopolis, Pa., for the last five years.

Arthur G. Eaton has been made vice president of the Aluminum Industries, Inc., Cincinnati, Ohio, manufacturers of Permite pistons. He has also been appointed as director of sales. Mr. Eaton, for the past fifteen years, has been connected with Dodge Brothers, Inc., serving in various executive capacities. For the last four years he has been director of purchases of the Dodge corporation. Mr. Eaton's headquarters will be in Detroit, where the Aluminum Industries has recently opened general sales offices on the seventh floor of the Fisher Building.

Business Reports in Brief

Eagle Foundry Company, St. Louis, Mo., has leased a site in East St. Louis, Ill., where it will move its assembly plant.

Extruded Metal Products Company, Wheeling, W. Va., Joseph Hillard, president, plans the construction of a new foundry.

Atlas Metal Bed Manufacturing Company, 3001 St. James Street, Montreal, Can., contemplates erection of a new manufacturing plant.

Smith and Stone, Ltd., Georgetown, Ont., Can., manufacturer of electrical supplies, etc., is planning an addition to cost $35,000.

Central Brass and Fixture Company, Springfield, Ohio, was damaged by fire recently. Immediate replacement of equipment is contemplated.

Chicago Foundry Company, 2028 North Major Avenue, Chicago, Ill., has awarded a contract for a two-story addition, 75 x 80 ft., to cost $8,500.

W. H. Robinson Metal Works, 278 Grove Street, Worcester, Mass., will soon start work on a one-story addition, 72 x 74 feet.

Bridgeport Brass Company, Bridgeport, Conn., has leased a building at 255 Jelliff Avenue, Newark, N. J., for a new factory branch and distributing plant.

Aluminum Company of America, has removed its office from 1228 Third National Building, Dayton, Ohio, to 910 Dixie Terminal Building, Cincinnati, Ohio.

C. Graessle, 113 Prospect Avenue, Irvington, N. J., has awarded contract for a two-story addition to factory for the manufacture of lighting equipment, at 111-113 Prospect Avenue. Estimated cost $40,000.

Allegheny Steel and Brass Corporation, 549 W. Washington Blvd., Chicago, Ill., has been appointed sales agent in Chicago territory for Keystone Steel and Wire Company, Peoria, Ill.

Palmer Brothers, Inc., 112 Front Street, Brooklyn, N. Y., manufacturer of electric appliances and equipment, plans rebuilding part of a six-story factory destroyed by fire February 14th.

Wheatley Brothers Brass and Metal Works, Tulsa, Okla., has acquired a two-acre site on Sand Springs Road, for a new plant including shop and office building.

J. C. Barrett Company, 516 Asylum Street, Hartford, Conn., manufacturer of aluminum plate, is having plans prepared for a two-story, 40 x 100 ft. factory on Elmwood Street. Estimated cost $40,000.

S. and S. Machine Die Casting Company, Providence, R. I., has purchased the plant formerly owned by William H. Hamblyn Company, Cranston, R. I., and will equip if for manufacturing.

Scovill Manufacturing Company, Chicago, Ill., has purchased property, 44 x 209 ft. at 1239 Washington Boulevard, and plans erection of a four-story warehouse.

American Electric Metal Corporation, Lewiston, Maine, will soon award a contract for a one-story, 110 x 130 ft. plant and laboratory. Estimated cost $65,000.

Geometric Stamping Company, 221 East 131st Street, Cleveland, Ohio, manufacturer of metal stampings, etc., is disposing of a bond issue of $350,000, part of the fund to be used for general expansion.

Kennedy Manufacturing Company, Lutzville, Pa., has taken over a local factory and will manufacture metalware specialties. The building will be improved and machinery installed at once.

Absolute Con-Tac-Tor Company, Elkhart, Ind., manufacturer of automatic electric control devices, etc., is completing plans for a one-story addition, to cost about $65,000 with equipment.

Davenport Brass Foundry, Davenport, Iowa, has filed petition in voluntary bankruptcy. Schedules have not been filed. George Meckel is secretary and J. B. Phillips, treasurer of the company.

An order has been signed directing sale of the assets of the **Marr Bronze Foundry, Inc.,** Buffalo, N. Y. The assets have been assigned to Roland H. Tills for the benefit of creditors.

Eljer Company, Ford City, Pa., maker of sanitary ware, has purchased the plant and business of the National Sanitary Company, Salem, Ohio. The Salem plant will continue to operate as a branch. The company also is planning an expansion program.

Krone-Sebek Die Casting and Manufacturing Company, Chicago, Ill., has moved from 64 West Austin Avenue to a new building at the corner of West Forty-seventh Street and Richmond Avenue, recently purchased containing 54,000 sq. ft. of floor space.

Illinois Electric Company, 314 West Madison Street, Chicago, Ill., electrical supplies and equipment, will soon begin superstructure for a four-story and basement storage and distributing plant to cost about $400,000 with equipment.

Simmons Company, Kenosha, Wis., manufacturer of brass and iron bedsteads, etc., is planning for second unit at factory branch and distributing plant at San Francisco, to be three stories and to cost about $50,000.

Nordendale Manufacturing Company, 1638 North Paulina Street, Chicago, Ill., manufacturer of metal stampings, plans the construction of a two-story, 48 x 125 ft. factory at Hoyne Avenue and Fulton Street. Estimated cost, $30,000.

Schlangen Brothers Company, 2435 Irving Park Blvd., Chicago, Ill., manufacturer of hardware, miscellaneous brass goods, barrel filling machinery, etc., is having sketches made for the construction of a three-story factory. Estimated cost $200,000.

East St. Louis Casting Company, Sixteenth and Kansas Streets, East St. Louis, Ill., will erect a new one-story foundry, 110 x 240 ft., which will triple present capacity. Building and equipment will cost about $200,000.

Metalcraft Corporation, 1501 Penrose Avenue, St. Louis, o., manufacturer of metal toys and novelties, has begun work on a one-story addition to cost about $75,000 with equipment, for which general contract recently was let.

Metal Stamping Corporation, West Bend, Wis., manufacturer of automobile stampings, contemplates erection of a new shop containing about 20,000 sq. ft. Details have not been determined upon. C. P. Davey is general manager.

Samuel Stamping and Enameling Company, Chattanooga, Tenn., has arranged for an increase in capital by amount of $100,000, practicaly entire fund to be

used for expansion and improvements on which work is now in progress.

Electric Sprayit Company, Stephenson Building, South Bend, Ind., Simon Deutsch, president, manufacturer of spraying equipment, etc., contemplates a one-story addition to plant in Belleville section, to cost about $45,000 with equipment.

Kerotest Manufacturing Company, 2525 Liberty Avenue, Pittsburgh, Pa., manufacturer of brass and steel valves, etc., has asked bids on general contract for a three-story addition, with machine shop, to cost about $100,000 with equipment.

Goehringer Foundry Supply Company, 919 W. Fifth Street, Cincinnati, Ohio, recently formed, is now operating, manufacturing foundry facings and foundry supplies. E. J. Goehringer is president and William F. Hunsche, secretary-treasurer.

Syracuse Bronze Company, Syracuse, N. Y., recently organized, by Ernest R. Cook, 319 W. Genesee Street, and associates, plans operation of local factory to manufacture brass, bronze and aluminum goods. George P. Sawyer, Baldwinsville, N. Y., is also interested in the new company.

J. B. Ripley Brass Foundry, Inc., Windsor, Vt., recently has acquired 4 acres of land adjoining the Central Vermont railroad, and soon will erect a new foundry building. It will be 40 x 140 ft. and will have the latest equipment for the manufacture of nonferrous castings.

Grand Rapids Metalcraft Corporation, Grand Rapids, Mich., is considering a new branch plant at Detroit, to manufacture a ventilating heater unit, recently acquired through acquisition of Kelch Ventilating Heater Company, to cost more than $60,000 with equipment.

American Electro-Metal Corporation, care of Chamber of Commerce, Lewiston, Me., affiliated with a company in Germany, has acquired about 15 acres on Lewiston Highway as a site for a new plant, to manufacture electrical appliances. Initial works will cost about $90,000.

General Welder Company, 95 Steiner Avenue, Akron, Ohio, incorporated recently with $100,000 capital, has a fully equipped machine shop, pattern works, bronze, copper and gray iron foundries in connection with its plant. It will manufacture special welding machines, and contemplates the manufacture of standard machines.

Pines-Winterfront Company is erecting a new $3,000,000 plant at Cicero and Division Streets, Chicago, Ill. The ground floor will be given over to production machinery and the tool department, while executive offices, finishing rooms, laboratories will be on the second. A large chromium plating department is to be featured.

Buffalo Ornamental Bronze and Iron Works, Buffalo, N. Y., recently formed with capital of $50,000 by W. G. Hickman, 6 Granger Place, and associates, plans operation of a local factory for architectural and ornamental iron, bronze and other metal specialties. W. J. Schabel, 604 Goodyear Avenue, is also interested in the company.

Summit Brass and Bronze Company, Akron, Ohio, and the Newton Foundry Company, Barberton, Ohio, have been consolidated into the Summit-Newton Foundry Company, located at 241 East State Street, Barberton. The firm is equipped to manufacture iron, semi-steel, brass, bronze and aluminum castings. It also will make patterns. John Zamarik is president of the company.

Scott Valve Manufacturing Company, 3963 McKinley Avenue, Detroit, Mich., formerly Rose Stephens Manufacturing Company, has been reorganized and facilities will be increased for manufacture and distribution of Scott valves. Officers are: Alexander Gow, president; John A. Baas, vice-president; A. DeLong Thomas, secretary, and Guy C. Powell, treasurer.

Hoover Suction Sweeper Company, North Canton, Ohio, manufacturer of vacuum cleaning equipment, is considering construction of two new four-story units, one for general production and the other for engineering, service division and similar operations, to cost more than $225,000 with equipment. The company recently arranged for increase in capital from 20,000 to 140,000 shares of common stock, no par value.

Fillkwik Company, Horton-Angell Building, Attleboro, Mass., has completed negotiations for the purchase of the Williams Company, Attleboro. The machinery, tools and equipment of the latter concern will be moved to the Fillkwik plant shortly. The Williams Company manufactures compacts, vanities and jewelry novelties. It is stated that the merger of the two firms will not include the costume jewelry of the one absorbed.

Anchor Cap Corporation, 59 E. Eighth Street, New York, manufacturer of metal caps for bottles and capping machines, is planning early removal of the plant of the American Metal Cap Company, Summit Street, Brooklyn, recently acquired, to its main operating unit, Anchor Cap and Closure Corporation, Long Island City, where production will be consolidated. The last noted plant will be enlarged. The parent company is arranging for a sale of additional stock, proceeds to be used in part for expansion.

New Companies

The Buffalo Porcelain Enameling Corporation, Buffalo, N. Y., is installing an electric type continuous porcelain enameling furnace at its plant.

Apex Pattern and Foundry Company, 5814 S. Wood Street, Chicago, Ill., has been incorporated with $15,000 capital to manufacture and deal in castings, household wares, etc., by C. P. Stake.

Atoz Packing Company, 109 Tichnor Street, Newark, N. J., has been organized to manufacture Atoz packing, a metallic material. The company is in operation.

Zeller Lacquer Manufacturing Company, Inc., 20 East 49th Street, New York City, has appointed **Horace E. Hall** to the position of sales manager, according to a statement from **Hugo Zeller,** treasurer.

International Chemical Company, Philadelphia, Pa., has appointed **L. Eugene Punderson,** 1859 Sheldon Road, Cleveland, Ohio, as sales engineer in the northern Ohio territory.

Blue Devil Fire Extinguisher Company, 469 Broad Street, Newark, N. J., has been organized to manufacture fire extinguisher for use on automobiles and motor boats. The Company has a factory in E. Tenth Street, New York, and is in production.

Millard J. Roberts, 95 Scott Street, Tonawanda, N. Y., and associates, have organized Roberts Appliance Company, and plan establishment of a plant at Buffalo, to manufacture gas burners, heaters and kindred subjects.

The Monarch Aluminum Ware Company, Cleveland, Ohio, has removed its plant and offices to the new location at 9301 Detroit Avenue, where there will be materially increased space and the latest types of labor saving equipment.

Weaver Brothers Company, formerly of Clinton, Mich., have removed their plant and equipment to Adrian, Mich., where they will be in a better position for distribution to the trade. The company specializes in pickling supplies and equipment.

Canadian Compression Joints, Ltd., Vancouver, B. C., Can., has been incorporated to manufacture and deal in metal and metal products, and to carry on the business as founder, with $150,000 capital and 300,000 shares no par value stock, by J. C. Boyes, L. G. Scott, G. W. Scott and others, all of Vancouver.

Northside Pattern and Foundry Company, 3616 Colerain Avenue, Cincinnati, Ohio, has been organized to succeed Buckeye Pattern Works, manufacturer of metal and wood patterns. The new company has erected addition, now in operation, to manufacture brass and aluminum castings.

Cooper-Kumpf Manufacturing Company, Racine, Wis., has been organized by A. H. Kumpf, 1815 St. Clair Street, and F. Cooper, 800 Lake Avenue, to manufacture electrical appliances and fractional horsepower motors. A building has been leased and inquiry is being made for equipment.

Woodrow National Corporation 24 N. Spaulding Avenue, Chicago, Ill., has been incorporated with capital of $110,000, to manufacture and deal in products and combinations of wood, brass, copper, tin, steel, iron, lumber, rubber, etc. The incorporators are: M. Levin, M. W. Goldstein and E. E. Cook; correspondent, S. M. Rosenthal, 127 N. Dearborn Street.

Handy and Harman, 57 William Street, New York City, announce the following changes in their personnel: **George C. Gerrish** has resigned as vice-president in charge of manufacturing and refining operations. **Gustav H. Niemeyer** has been appointed vice-president in charge of sales, manufacturing and refining operations. **Robert H. Leach** has been appointed manager of the Bridgeport, Conn., plant.

National Rivet and Manufacturing Company, ft. of Park Place, Milwaukee, Wis., has been incorporated for the purpose of manufacturing brass, copper, aluminum and steel rivets of the solid, semi-tubular, tubular and split types used for brake-bands and facings for all classes of machinery, airplanes, etc. The new company absorbs the U. S. Rivet and Mfg. Company of Mishawaka, Ind. The officers are P. H. Dorr, president; W. Fleming, Jr., secretary and treasurer.

The Roller-Smith Company, 233 Broadway, New York City, has made the following additions to its sales organization:—**Jackson Brown, Jr.,** 701 Kittridge Building, Denver, Col., will represent the company in Colorado, Utah, Wyoming and northern New Mexico. **The Manila Machinery and Supply Company, Inc.,** Manila, Philippine Islands, will represent the company in the Philippines. The Roller-Smith Company manufactures electrical measuring instruments, relays, circuit breakers, etc.

Trade Publications

Battery Charging Equipment. General Electric Company, Schenectady, N. Y. Illustrated leaflet.

Grinding and Sharpening Machinery. Samuel C. Rogers and Company, 191 Dutton Avenue, Buffalo, N. Y. Complete 1929 illustrated catalog and price-list.

Exterior Lighting and the Use of Lanterns. Artistic Lighting Equipment Association, 711 Graybar Building, Lexington Avenue, New York City. Booklet illustrated in colors.

Daniels Plating Equipment. The Daniels and Orben Company, Inc., 81 Walker Street, New York City. Various types of mechanical plating apparatus. Illustrated pamphlet.

Making Steel Stand More Strain. The Brown Instrument Company, Philadelphia, Pa. Pyrometer control in manufacture of Stillson wrenches. Also, Power Plant Instrument Data Book, an extensive, illustrated booklet.

Unit Heater Bulletin. L. J. Wing Manufacturing Company, 154 West 14th Street, New York City. History and development of unit heating, with descriptions of Wing factory installations, and illustrations.

Chromium Plating Equipment. Connecticut Dynamo and Motor Company, Lyons Avenue, Irvington, N. J. Leaflet on apparatus for chromium plating; well illustrated. Covers generators, rheostats, exhaust fans, small chromium outfit for jewelers, etc.

Advertisements which Reflect the Scope of R and H Chemicals and Service. The Roessler and Hasslacher Chemical Company, 10 East 40th Street, New York City. Interesting 24-page illustrated booklet showing the company's various advertisements.

White Metal and Brass Pattern Letters and Figures. H. W. Knight and Son, Seneca Falls, N. Y. Catalog of pattern letters and figures used in production of lettered and figured metal castings, tablets, monuments, etc. Other equipment for this work is also included.

Electro Chemical Deposition of Metals. Fescol, 101 Grosvenor Road, Westminster, London, Eng., S.W.1. A 128-page book covering in an interesting fashion a patented process of plating with nickel, copper, chromium, cadmium, cobalt, iron, lead or zinc. A great number of illustrations are included in the book.

Review of the Silver Market for 1928. Handy and Harman, New York. This is the annual review of the silver market which has been issued by this firm for many years and become recognized as one of the most authoritative summaries on silver. It is their judgment, barring unforeseen developments, that the average price level of silver during 1929 will not be far distant from that of 1928.

The A B C of Hydrogen Ion Control. LaMotte Chemical Products Company, Baltimore, Md. This is the fifth and enlarged edition of a work that has proven its worth in past years as a combination catalog and textbook. The extensive use into which control of acidity and alkalinity by means of hydrogen ion measurements has come makes this book highly valuable to everyone interested in production of high quality plated ware. It covers the subject thoroughly, from the definition of hydrogen ion concentration and the applications of pH values through various methods of measurement, materials for analysis and control and various other important phases involved.

Metal Prices, March 22, 1929

NEW METALS

Copper: Lake, 24.125. Electrolytic, 24.00. Casting, 23.75.
Zinc: Prime Western, 6.60. Brass Special, 6.70.
Tin: Straits, 49.00. Pig, 99%, 48.25.
Lead: 7.90. **Aluminum,** 24.30. **Antimony,** 9.875.
Nickel: Ingot, 35. Shot, 36. Elec. 35. Pellets, 40.
Quicksilver: flask, 75 lbs., $123. **Bismuth,** $1.70.
Cadmium, 95. **Cobalt,** 97%, $2.60. **Silver,** oz., Troy, 56.625.
Gold: oz., Troy, $20.67. **Platinum,** oz., Troy, $66.50.

INGOT METALS AND ALLOYS

Brass Ingots, Yellow	15½to16½
Brass Ingots, Red	19 to20
Bronze Ingots	20 to21
Casting Aluminum Alloys	21 to24
Manganese Bronze Castings	24 to40
Manganese Bronze Ingots	18 to20
Manganese Bronze Forgings	32 to42
Manganese Copper, 30%	30 to40
Monel Metal Shot	28
Monel Metal Blocks	28
Parsons Manganese Bronze Ingots	19 to21
Phosphor Bronze	20 to22
Phosphor Copper, guaranteed 15%	25 to28
Phosphor Copper, guaranteed 10%	24 to27
Phosphor Tin, no guarantee	55 to70
Silicon Copper, 10%.....according to quantity.....	30 to35

OLD METALS

Buying Prices		Selling Prices
15½to16	Heavy Cut Copper	16½to17
15 to15¼	Copper Wire, mixed	16 to16¼
12¾to13	Light Copper	13¾to14
10¾to12	Heavy Machine Composition	11¾to13
8¾to 9	Heavy Brass	9¾to10
7¼to 7½	Light Brass	8¼to 8½
10¼to10½	No. 1 Yellow Brass Turnings	11¼to11½
10¾to11	No. 1 Composition Turnings	11¾to12
5½to 5¾	Heavy Lead	6¾to 7
3½to 3¾	Zinc Scrap	4¾to 5¼
8 to10	Scrap Aluminum Turnings	12½to14¼
13 to13½	Scrap Aluminum, cast alloyed	17½to18½
19 to20	Scrap Aluminum sheet (new)	22 to22½
30½to32	No. 1 Pewter	35 to38
20 to21	Old Nickel Anodes	22 to23
20 to23	Old Nickel	22 to25

Wrought Metals and Alloys

COPPER SHEET

Mill shipment (hot rolled).....30¾ to 31¾c. net base
From Stock .....31¾ to 32¾c. net base

BARE COPPER WIRE

23⅝c. to 23⅞c. net base, in carload lots.

COPPER SEAMLESS TUBING

32⅛c. to 33⅛c. net base.

SOLDERING COPPERS

300 lbs. and over in one order.....29¼c. net base
100 lbs. to 200 lbs. in one order.....30¼c. net base

ZINC SHEET

Duty sheet, 15% Cents per lb.
Carload lots, standard sizes and gauges, at mill, less 7 per cent discount .....9.75 net base
Casks, jobbers' price .....10.25 net base
Open Casks, jobbers' price .....10.75 to 11.00 net base

ALUMINUM SHEET AND COIL

Aluminum sheet, 18 ga., base, ton lots, per lb. 33.30
Aluminum coils, 24 ga., base, price 31.00

ROLLED NICKEL SHEET AND ROD

Net Base Prices

Cold Drawn Rods..... 53c. Cold Rolled Sheet..... 60c.
Hot Rolled Rods..... 45c. Full Finished Sheet..... 52c.

BLOCK TIN SHEET

Block Tin Sheet—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more 10½c. over Pig Tin; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 17c. over; less than 25 lbs., 25c. over.

SILVER SHEET

Rolled sterling silver 57¼ to 59¼ per ounce, Troy.

BRASS MATERIAL—MILL SHIPMENTS

In effect March 16, 1929
To customers who buy 5,000 lbs. or more in one order.

	Net base per lb. High Brass	Low Brass	Bronze
Sheet	$0.24⅞	$0.27	$0.28½
Wire	.25⅜	.27½	.29
Rod	.22⅝	.27¾	.29¼
Brazed tubing	.32⅞	....	.38⅛
Open seam tubing	.32⅞	....	.36½
Angles and channels	.32⅞	....	.36½

BRASS SEAMLESS TUBING

29¾c. to 30¾c. net base.

TOBIN BRONZE AND MUNTZ METAL

Tobin Bronze Rod	27c. net base
Muntz or Yellow Metal Sheating (14"x48")	25½c. net base
Muntz or Yellow Rectangular sheet other Sheathing	26½c. net base
Muntz or Yellow Metal Rod	23½c. net base

Above are for 100 lbs. or more in one order.

NICKEL SILVER (NICKELENE)

Net Base Prices

Grade "A" Sheet Metal		Wire and Rod	
10% Quality	32⅝c.	10% Quality	35⅝c.
15% Quality	34⅛c.	15% Quality	39⅜c.
18% Quality	35⅜c.	18% Quality	42⅝c.

MONEL METAL SHEET AND ROD

Hot Rolled Rods (base)	35	Full Finished Sheets (base)	42
Cold Drawn Rods (base)	40	Cold Rolled Sheets (base)	50

BRITANNIA METAL SHEET

No. 1 Britannia—18" wide or less, No. 26 B. & S. Gauge or thicker, 500 lbs. or over, 8c. over N. Y. tin. price; 100 lbs. to 500 lbs., 10c. over; 50 to 100 lbs., 15c. over; 25 to 50 lbs., 20c. over; less than 25 lbs., 25c. over. Prices f. o. b. mill.

Supply Prices, March 22, 1929

ANODES

Copper:	Cast	26½c. per lb.
	Rolled oval	26 c. per lb.
	Rolled sheets, trimmed	26¼c. per lb.
Brass:	Cast	25½c. per lb.
Zinc:	Cast	12¼c. per lb.
Nickel:	90-92%	45c. per lb.
	95-97%	47c. per lb.
	99%	49c. per lb.

Silver: Rolled silver anodes .999 fine are quoted from 59⅛ to 61⅛c., Troy ounce, depending upon quantity.

FELT POLISHING WHEELS WHITE SPANISH

Diameter	Thickness	Under 100 lbs.	100 to 200 lbs.	Over 200 lbs.
10-12-14 & 16"	1" to 3"	$3.00/lb.	$2.75/lb.	$2.65/lb.
6-8 & over 16	1 to 3	3.10	2.85	2.75
6 to 24	Under ½	4.25	4.00	3.90
6 to 24	½ to 1	4.00	3.75	3.65
6 to 24	Over 3	3.40	3.15	3.05
4 up to 6	¼ to 3	4.85	4.85	4.85
4 up to 6	Over 3	5.25	5.25	5.25
Under 4	¼ to 3	5.45	5.45	5.45
Under 4	Over 3	5.85	5.85	5.85

Grey Mexican Wheel deduct 10c per lb. from White Spanish prices

COTTON BUFFS

Full Disc Open buffs, per 100 sections.

12" 20 ply 64/68 Unbleached	$28.10
14" 20 ply 64/68 Unbleached	37.15
12" 20 ply 80/92 Unbleached	31.50
14" 20 ply 80/92 Unbleached	42.85
12" 20 ply 84/92 Unbleached	40.80
14" 20 ply 84/92 Unbleached	54.60
12" 20 ply 80/84 Unbleached	37.40
14" 20 ply 80/84 Unbleached	50.45

Sewed Pieced Buffs, per lb., bleached ..... 48c to 64c

CHEMICALS

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone	lb.	.14-.19
Acid—Boric (Boracic) Crystals	lb.	.08½
Chromic 100 and 400 lb. drums	lb.	.20½-.21
Hydrochloric (Muriatic) Tech., 20°, Carboys	lb.	.02
Hydrochloric, C. P., 20 deg., carboys	lb.	.06
Hydrofluoric, 30% bbls.	lb.	.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07
Sulphuric, 66 deg., carboys	lb.	.02
Alcohol—Butyl	lb.	.17¼-.21¾
Denatured, drums	gal.	.48-.56
Alum—Lump, Barrels	lb.	.03¼
Powdered, Barrels	lb.	.039
Aluminum sulphate, commercial tech	lb.	3.3
Aluminum chloride solution in carboys	lb.	.06½
Ammonium—Sulphate, tech., bbls.	lb.	3.3
Sulphocyanide	lb.	.65
Arsenic, white, kegs	lb.	.05
Asphaltum	lb.	.35
Benzol, pure	gal.	.60
Borax Crystals (Sodium Biborate), bbls	lb.	.04½
Calcium Carbonate (Precipitated Chalk)	lb.	.04
Carbon Bisulphide, Drums	lb.	.06
Chrome Green, bbls.	lb.	.28
Chromic Sulphate	lb.	.37
Copper—Acetate (Verdigris)	lb.	.23
Carbonate, bbls.	lb.	.19
Cyanide (100 lb. kegs)	lb.	.50
Sulphate, bbls.	lb.	6.9
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.27
Crocus	lb.	.15
Dextrin	lb.	.05-.08
Emery Flour	lb.	.06
Flint, powdered	ton	$30.00
Fluor-spar (Calcic fluoride)	ton	$70.00
Fusel Oil	gal.	$4.45
Gold Chloride	oz.	$14.00
Gum—Sandarac	lb.	.26
Shellac	lb.	.59-.61
Iron Sulphate (Copperas), bbl.	lb.	.01½
Lead Acetate (Sugar of Lead)	lb.	.13¼
Yellow Oxide (Litharge)	lb.	.12½
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Nickel—Carbonate, dry, bbls.	lb.	.30
Chloride, bbls.	lb.	.18
Salts, single, 300 lb. bbls.	lb.	.13
Salts, double, 425 lb. bbls.	lb.	.13
Paraffin	lb.	.05-.06
Phosphorus——Duty free, according to quantity	lb.	.35-.40
Potash, Caustic Electrolytic 88-92% broken, drums	lb.	.09
Potassium Bichromate, casks (crystals)	lb.	.09¼
Carbonate, 96-98%	lb.	.07
Cyanide, 165 lb. cases, 94-96%	lb.	.57½
Pumice, ground, bbls.	lb.	.02½
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Rouge, nickel, 100 lb. lots	lb.	.25
Silver and Gold	lb.	.65
Sal Ammoniac (Ammonium Chloride) in casks	lb.	.05½
Silver Chloride, dry, 100 oz. lots	oz.	.46½
Cyanide (fluctuating)	oz.	.57-.60
Nitrate, 100 ounce lots	oz.	.40
Soda Ash, 58%, bbls.	lb.	.02½
Sodium—Cyanide, 96 to 98%, 100 lbs	lb.	.18
Hyposulphite, kegs	lb.	.04
Nitrate, tech., bbls.	lb.	.04¾
Phosphate, tech., bbls.	lb.	.03¾
Silicate (Water Glass), bbls.	lb.	.02
Sulpho Cyanide	lb.	.32½
Sulphur (Brimstone), bbls.	lb.	.02
Tin Chloride, 100 lb. kegs	lb.	.38
Tripoli, Powdered	lb.	.03
Wax—Bees, white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
Whiting, Bolted	lb.	.02½-.06
Zinc Carbonate, bbls.	lb.	.11
Chloride, casks	lb.	.06¾
Cyanide (100 lb. kegs)	lb.	.41
Sulphate, bbls.	lb.	.03¾